California High-Speed Rail Project

Cost Changes from 2009 Report to 2012 Business Plan Capital Cost Estimates

October, 2011

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1.0 INTRODUCTION

1.1 PURPOSE

This technical report provides an accounting of the changes between the capital cost estimates as presented in the 2009 Report to the Legislature (2009 Report) and the estimates prepared for the 2012 Business Plan (2012 BP). The 2012 BP estimates reflect the DEIR/S for Merced-Fresno and Fresno-Bakersfield, and "snapshot" capital cost estimates based on available information for the remaining Phase 1 sections. A low and high cost estimate is assessed for those sections with multiple alternative alignments and options. This memorandum also identifies and categorizes the key drivers for cost differences by section of the CHSTP system. For comparison purposes, cost estimates from the 2009 Report and prepared to support the 2012 BP are presented in base year 2010 dollars (2010$).

1.2 CAPITAL COST SUMMARY

Exhibit 1 Capital Cost Summary is presented by section. These costs are exclusive of vehicle and heavy maintenance facility costs as these are not attributable to individual sections or awaiting decision. The table includes both a lower cost and higher cost scenario based on the range of options included in the environmental and preliminary engineering studies. The San Francisco-San Jose section does not include a range as there is currently a single practical alignment under consideration that fulfills the performance requirements. The current estimate (Option A) represents a four-track arrangement for the peninsula corridor. However, blended operations capable of delivering a one-seat ride to San Francisco are possible and require substantially fewer four-track sections. These options are described in the Business Plan as Phase 1 Blended operations.

FRA STANDARD COST CATEGORIES BASE YEAR FY 2010 $ (Billions)	Phase 1		San Francisco - San Jose	San Jose - Merced		Merced-Fresno		Fresno - Bakersfield		Bakersfield - Palmdale		Palmdale - Los Angeles		Los Angeles - Anaheim	
	Lowest Cost Option	Highest Cost Option	Option A	Lowest Cost Option	Highest Cost Option	Lowest Cost Option	Highest Cost Option	Lowest Cost Option	Highest Cost Option	Lowest Cost Option	Highest Cost Option	Lowest Cost Option	Highest Cost Option	Lowest Cost Option	Highest Cost Option
10 TRACK STRUCTURES & TRACK	$ 30.4	$ 37.3	$ 7.1	$ 6.8	$ 9.3	$ 1.4	$ 3.5	$ 2.3	$ 2.9	$ 5.2	$ 5.3	$ 5.9	$ 6.8	$ 1.7	$ 2.4
20 STATIONS, TERMINALS, INTERMODAL	$ 3.3	$ 3.7	$ 1.8	$ 0.5	$ 0.5	$ 0.1	$ 0.1	$ 0.3	$ 0.3	$ -	$ -	$ 0.2	$ 0.2	$ 0.5	$ 0.8
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$ 0.4	$ 0.4	$ 0.2	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ -	$ -	$ 0.0	$ 0.0	$ -	$ -	$ 0.1	$ 0.1
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$ 14.7	$ 14.9	$ 1.9	$ 3.2	$ 3.4	$ 1.2	$ 1.4	$ 1.9	$ 2.2	$ 0.6	$ 0.6	$ 3.5	$ 3.9	$ 2.4	$ 1.5
50 COMMUNICATIONS & SIGNALING	$ 1.0	$ 1.0	$ 0.2	$ 0.2	$ 0.2	$ 0.1	$ 0.2	$ 0.2	$ 0.2	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ 0.1
60 ELECTRIC TRACTION	$ 3.0	$ 3.2	$ 0.5	$ 0.5	$ 0.6	$ 0.4	$ 0.5	$ 0.6	$ 0.6	$ 0.4	$ 0.4	$ 0.3	$ 0.3	$ 0.2	$ 0.2
70 VEHICLES	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-60)	$ 6.5	$ 7.5	$ 1.4	$ 1.5	$ 1.8	$ 0.4	$ 0.7	$ 0.6	$ 0.7	$ 0.8	$ 0.9	$ 1.1	$ 1.3	$ 0.6	$ 0.6
90 UNALLOCATED CONTINGENCY	$ 2.2	$ 2.6	$ 0.5	$ 0.5	$ 0.6	$ 0.1	$ 0.2	$ 0.2	$ 0.3	$ 0.3	$ 0.3	$ 0.4	$ 0.5	$ 0.2	$ 0.2
TOTAL:	$ 61.4	$ 70.5	$ 13.6	$ 13.2	$ 16.4	$ 3.7	$ 6.6	$ 6.2	$ 7.2	$ 7.5	$ 7.7	$ 11.6	$ 13.1	$ 5.6	$ 6.0

2.0 ASSESSMENT

2.1 GENERAL

Formal capital cost estimates are generated on a milestone basis (i.e. Business Plan, Final 15% Design Submittal, etc.). As the sections progress, "snapshot" capital cost estimates are prepared to assess the program wide cost implications and cumulative impacts as each of the Phase 1 sections progress through preliminary engineering and environmental assessment. While formal capital cost estimates are developed from milestone deliverables, snapshot estimates are based on design information available at that time. Both estimates rely on two sets of data: Quantities and Composite Unit Prices. Composite Unit Prices represent cost of major elements (viaduct, tunnel, track, etc.) on a unit basis, typically on a per mile length. Adjustments to either or both of these data sets can have significant effect on the capital cost estimates.

Since the conceptual design effort reflected in the 2009 Report, there have been significant scope additions due to advancement of the design, better understanding of the site conditions, and input from local stakeholders and the community during the project-level environmental review process. This process has generated multiple alignment alternatives for most of the sections and results in a range of costs for each section. For purposes of this memorandum, the least and most costly alignment alternatives are assessed. The scope changes that make up the majority of cost changes are identified by section in further detail in Appendix A.

The cost estimating methodology used for the CHSTP Program (Quantities x Unit Prices by Cost item) does not currently take fully take into consideration other factors that might affect costs. Factors that might reduce construction cost estimates include:

- Market conditions – Unit prices are developed on the basis of available current or historical cost data for materials, equipment and labor. It does not necessarily take into account an assessment of near term market conditions.
- Economies of Scale – There is one composite unit price per cost item which is not scaled up or down relative to the volume of the work. In general, efficiencies in terms of design and construction can be anticipated depending on the volume of work in a given contract.
- Alternative Delivery Methods – Composite Unit Prices include construction methods and production rates but does not account for efficiencies for alternative delivery methods in which the contractor has greater flexibility for design and construction, such as Design-Build.

One factor that might increase the construction cost estimates is that several sections are still undergoing environmental review and alternatives development. Cost increases may occur to mitigate impacts to environmental resources or from technical issues arising from new information on site conditions. The ranges of costs developed for the 2012 Business Plan have been designed to account for the different alternatives under consideration and contingencies have been added to mitigate against the risks associated with cost increases for unaccounted items and potential composite unit price cost escalation.

2.2 PHASE OF DEVELOPMENT

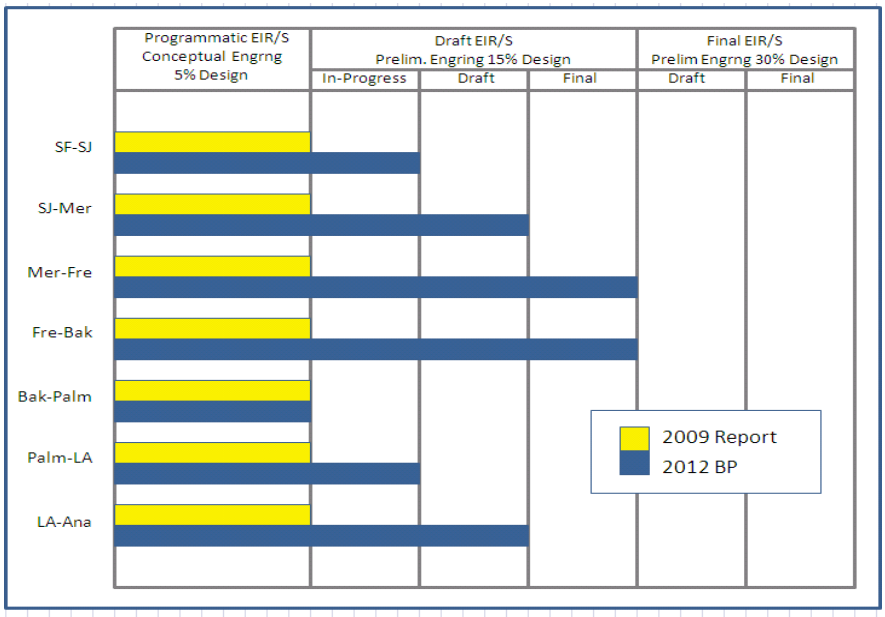
Quantities are developed from design submittals which can be at different stages of development. For the CHSTP, the stages of development are:

- 5% Design Submittal-- Conceptual Engineering (Programmatic EIR/S)
- 15% Design Submittal (In-Progress, Draft, Final) – Preliminary Engineering to support Project-Level Draft EIR/S
- 30% Design Submittal (Draft, Final) – Preliminary Engineering to support procurement

The 15% Design has three stages of development including In-Progress, Draft, and Final (AKA 15% Design Record Set). The 30% Design will have two stages of development including Draft and Final (AKA 30% Design Record Set).

Design level of completion is a key factor in providing context for the capital cost estimate. The ability and opportunity to affect capital costs is reduced as the design progresses through these stages of development. As previously noted, there are several milestone development levels for the CHSTP design submittals. Both the 2009 Report and 2012 BP estimates include sections at different stages of development due to differing schedules for environmental approval. In the 2009 Report, only one alignment option for one of the sections (LA-Ana – Dedicated Alternative) had progressed to Final 15% Design, and two sections in the Central Valley (Mer-Fre and Fre-Bak) had progressed to a Draft 15% level of completion. All other sections were in earlier phases of engineering and development. For the 2012 BP, the two central valley sections are at Final 15% Design with the rest at 15% In-Progress or Draft design, with the exception of the Bakersfield-Palmdale section which remained at the 5% Design level. Level of design completion as noted above is shown in the following exhibit.

Exhibit 2 -- Engineering Design Level of Completion at time of 2012 BP Estimate



2.3 CONTINGENCIES

The capital cost estimates are inclusive of contingencies, soft costs and mobilization costs as noted below, and are applied to the construction costs.

- 2009 Report – 30% for contingencies*, 15% for soft costs, 5% for mobilization
- 2012 BP – 10% to 25% for allocated contingencies, 5% for unallocated contingency, 13.5% for soft costs, 4 % for mobilization

  ** 20% contingencies is applied to Track, Electrification and Systems as construction risks are reduced given these are installed in an already built environment*

As the designs progress, contingencies are adjusted to reflect the level of engineering and level of detail in the composite unit costs. A contingency of 30% is included in the 2009 Report costs. The 2012 BP costs apply allocated contingency ranging from 10% to 25% by category of cost (track, structures, facilities, electrification, etc) depending on the level of detail in the build up of the unit price and the risk inherent in the quantities. For example, track length would have a lower contingency as the lengths are

well established, whereas unit prices for tunnel length would have a high contingency due to the unknown geologic conditions. In addition to the allocated contingency, and per FRA cost estimate categories established for the ARRA applications, a 5% Unallocated contingency is included in the 2012 BP estimates.

Soft costs were adjusted from the 2009 Report during preparation of the ARRA applications, and include costs for agency, program management, final design and construction management. The adjustments were applied following consideration of the size of potential contract packages, repetitive nature for the design and construction of key elements of the HST system, and the effect of multiple contracts.

For a multi-billion dollar construction contract package, it is typical to assume a 5% mobilization cost. For the CHSTP Program, mobilization costs have been reduced as contractors are likely to secure multiple contracts given the size, scope, and duration of the CHSTP construction program.

No consideration has been taken for other conditions that might further reduce costs during the proposal and bidding stage. These include adjustments for economies of scale, alternative delivery methods, and recent market conditions.

2.4 COMPOSITE UNIT PRICES

It has been calculated that approximately 85% of the cost increase is generated by scope growth and 15% of the cost increase is attributable to changes in composite unit prices. Scope growth has occurred during development of the alternatives to the 15% Design level and has typically been driven by stakeholder issues and more detailed information of the alignment site conditions. Composite Unit Price changes have principally been driven by a more refined and accurate approach to development of unit price. There has also been an expansion of key cost items (viaducts, tunnels) consistent with more detailed design and additional geotechnical information.

The 15% attribution of costs to changes in Composite Unit Price was determined by applying the 2012 BP unit prices to the 2009 Report quantities to determine the difference in total costs. The following table provides this comparison by major construction element.

Exhibit 3 –Comparison of 2009 Report and 2012 BP Composite Unit Prices

	CONSTRUCTION COSTS INCLUDING CONTINGENCIES		
Infrastructure Capital Costs	**2009 Report Unit Prices (2010 $MM)**	**15% Design UPEs (2010 $MM)**	**Adjusted Change in Unit Prices Relative to 2009 BP**
Track	$ 1,586	$ 1,594	1%
Viaducts/Bridges	$ 3,145	$ 3,135	0%
Tunnels	$ 3,869	$ 4,514	17%
Retaining Walls	$ 550	$ 910	65%
Grade Separations	$ 1,731	$ 1,678	-3%
Buildings	$ 2,852	$ 2,652	-7%
Rail and Utility Relocations	$ 798	$ 2,346	194%
System Elements	$ 1,495	$ 786	-47%
Electrification	$ 1,460	$ 2,499	71%
Subtotal Construction*	**$ 17,487**	**$ 20,114**	**15%**

* Earthwork not included in the analysis due to differences in estimating methodology

2.5 CAPITAL COSTS – 2009 REPORT VS. 2012 BP

The 2012 BP capital cost estimates are developed from a more detailed breakdown of cost items than was used for the 2009 Report estimates. It was necessary to summarize the 2012 BP costs similar to the 2009 Report to support this comparison analysis, including accounting for the differing contingencies and soft costs. The result is a margin of error of +/- 1%.

The current plans for the CHSTP have progressed from the Programmatic Phase towards the 15% Design Phase and include multiple changes in the design and cost of the system. The 2009 Report estimate is $35.7 billion and the 2012 BP estimates range from $65.2 to $74.2 billion depending on the alternative. The low and high cost estimates reflect specific alignment alternatives. Accounting for escalation (2% escalation applied to the 2009 Report results in $36.4 b), the cost increase ranges from $28.8 to 37.8 billion in 2010$. These costs include vehicles. Representing the best information available, the 2012 BP costs are considered a "snapshot" as it is based on alternatives that include alignment options which are still in development, and subject to further examination, study, and value engineering to reduce capital costs. A breakdown of cost differences by section and by discipline is as follows:

Exhibit 4 -- Costs by Section (2010$ MM)*

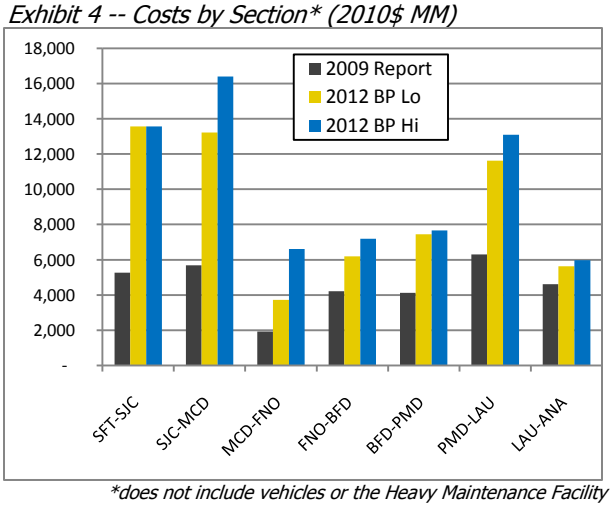
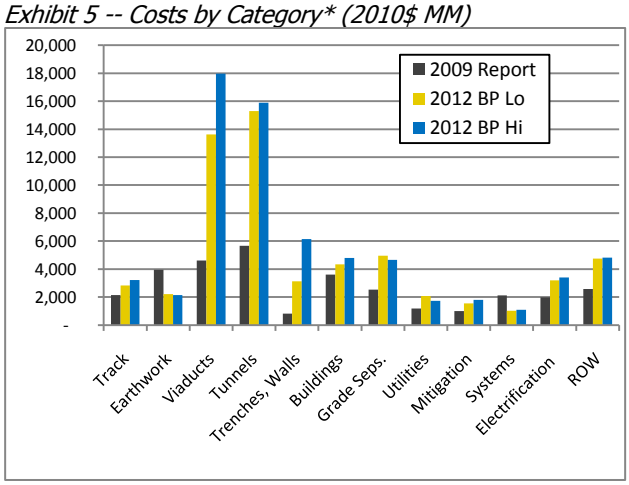
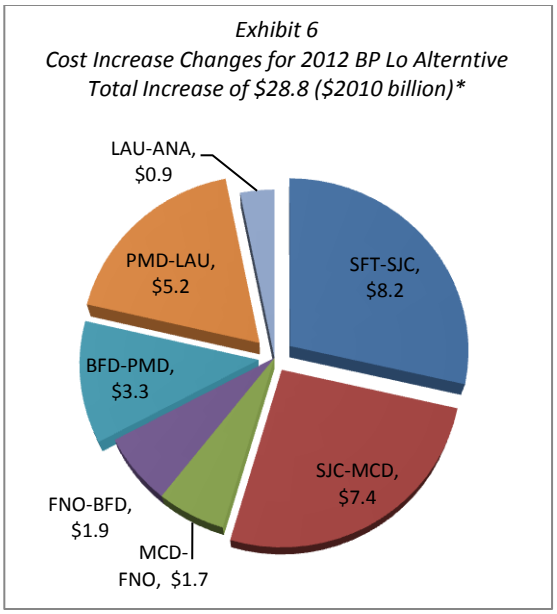


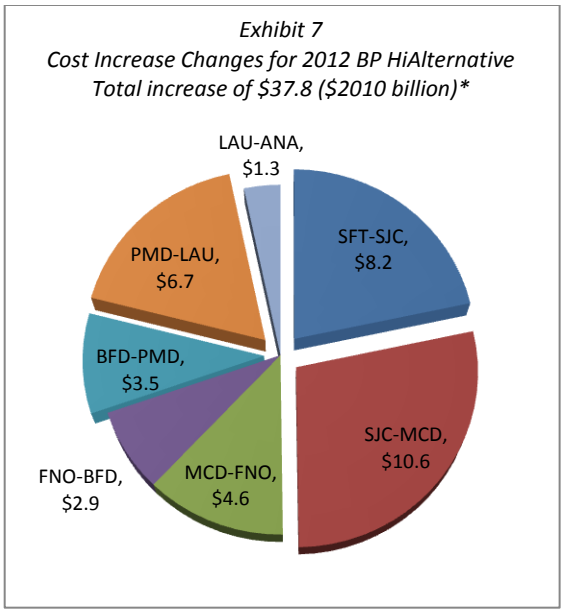
Exhibit 5 -- Costs by Category (2010$ MM)*



**does not include vehicles or the Heavy Maintenance Facility*

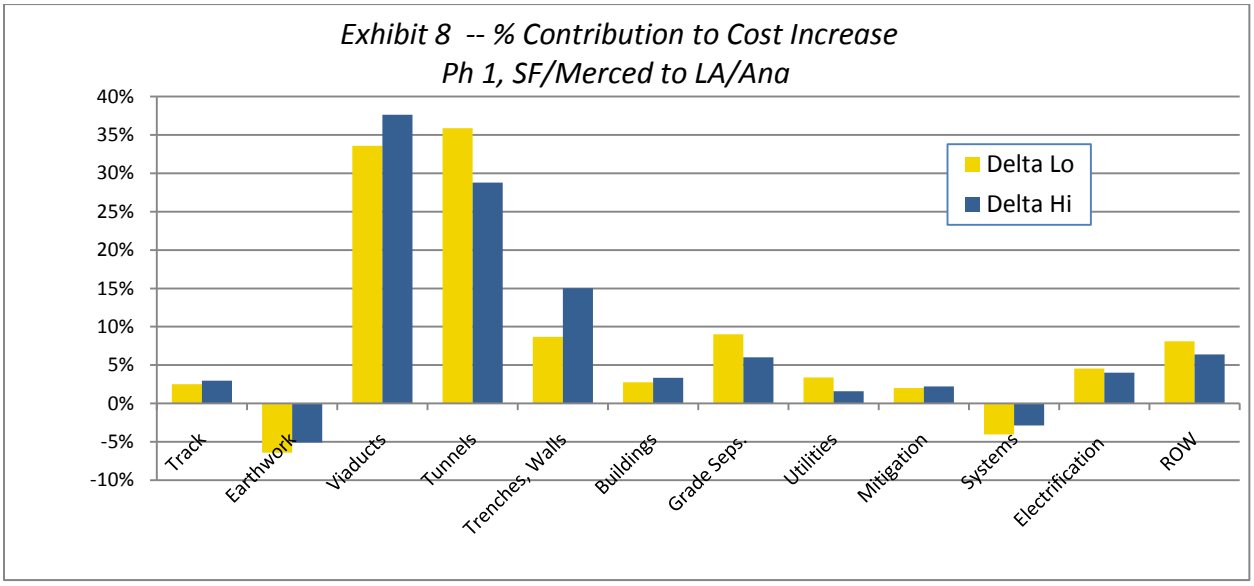
The graph for Costs by Section shows increases in estimated capital costs across all of the Phase 1 Sections. While all sections have seen an increase, about 80% of the increases are attributed to four sections: San Francisco-San Jose, San Jose-Merced, Bakersfield-Palmdale, and Palmdale-Los Angeles. The SF-SJ section includes the urban core of the Bay Area Peninsula where a shared-use four-track system with Caltrain is the current alternative. However, blended operations would be capable of delivering a one-seat ride to San Francisco without having continuous four tracks throughout the Peninsula corridor. The other three sections include the mountainous areas of the Pacheco Pass, Tehachapi Mountains, and the San Gabriel Mountains where increases in tunnels and viaducts have driven cost increases.





* may not total due to rounding

The drivers for cost increases vary for each section in terms of the categories of work affected. Regardless, there are notable trends that warrant further review. In reviewing the Costs by Category chart (Exhibit 5), there are four categories of the estimate that make up nearly 90% of the capital cost increase including viaducts, tunnels, trenches, and grade separations. This can be further seen in Exhibits 8 for all Phase 1 sections.



The Low - High Cost values for these four categories are:

- $13.6-17.9 billion or 34-38% for Viaducts and Bridges
- $15.3 -15.9 billion or 36-29% for Tunnels
- $3.1-6.1 billion or 9-15% for Trenches and Walls

- $4.9-4.7 billion or 9-6% for Grade Separations

These items are directly related to the alignment differences between the 2009 Report and the 2012 BP alternatives and options. The drivers for these alignment changes typically relates to one of four categories including land use, environmental, stakeholder, or engineering, for example:

- ***Land Use -*** In the Central Valley, community input has also resulted in changes to the alignments. At Hanford, the alignment in the Program EIR/S was west of the city. Because of stakeholder input regarding development between Hanford and the community of Armona, and the desire to locate a potential station to serve the Kings and Tulare region, the alignment was moved to the east side of Hanford. The east side alignment required elevated structures and higher embankments than previously considered in order to cross over the Kings River Complex floodplain, the San Joaquin Valley Railroad and SR 198 freeway. As of this writing, an alternative alignment west of Hanford is once again being considered in addition to the east side alignment. At this time, it is unknown how this new alternative will affect the cost. In the Southern California sections, there has been significant residential/retail development in the early-mid 2000's to the south east of Santa Clarita generally following the SR-14 corridor, much of this being single family homes. Development has additionally occurred through the foothill communities of Acton and Agua Dulce, and extensive residential/retail development has been seen through the Antelope Valley communities of Palmdale and Lancaster, again with a large proportion as single family dwellings. The original Programmatic alignment has been affected by these developments resulting in changed alignments requiring increased tunneling and viaducts.
- ***Environmental*** - Between Palmdale and Los Angeles, additional tunnels have been added in response to significant environmental effects as considered by the responsible federal resource agencies. In this section, the original alignment through the Soledad Canyon was eliminated due to adverse impacts discovered during the environmental impact process on protected species and habitats. The alignment alternatives, which were shifted into the mountainous areas to the north, require long tunnels due to the steep, rugged terrain. In addition, access for a high-speed route into downtown Los Angeles has required a tunnel approach under the LA River to avoid impacts to the existing Cornfields State Park just north of Los Angeles Union Station.
- ***Stakeholder*** – In the Program EIR/S, large sections of the HSR alignment were planned to be wholly co-located in existing transportation corridors such as the railroad and highway rights-of way. This was the case for the followings sections.
    - San Francisco south through Gilroy
    - Developed sections within the limits of Fresno, Tulare and Bakersfield
    - San Fernando Valley (approximately Sylmar to Media City)

  In addition, much of the central valley alignments from the Wye to Bakersfield were to be directly adjacent to existing railroad corridors. Coordination with the railroad and highway owner/operators, combined with large radius curves needed to maintain high speeds, resulted in alignments that cannot always be co-located in existing transportation corridor rights-of-way and are at times no longer adjacent, sometimes shifting the HSR alignments into residential and commercially developed areas. The result is an increase in viaducts to minimize local impacts and facilitate crossing of the existing railroad lines and highways. For example, the Program EIR/S alignment into Bakersfield followed the BNSF alignment through an existing refinery which was determined to be infeasible due to conflicts with the critical equipment and the associated piping. The alignment has been moved south of the refinery and is now in an adjacent corridor of the Westside Parkway freeway, which is now under construction. The current alignment is also elevated all the way from Calloway Drive to the station area in order to stay above the Westside Parkway and BNSF ROW. The original alignment only included elevated structures to cross the Kern River and SR 99, and for an elevated downtown station.

- ***Engineering*** – Improved understanding of seismic, terrain, geologic and geotechnical conditions have had a significant impact on costs for tunnels and aerial structures. For tunnels, in addition to some increase in length, costs increases are also driven by consideration of the tunnel lengths, expected soil conditions and construction methods. For aerial structures, seismic design criteria under development specific for the California High-Speed Train Project has resulted in some increases in composite unit prices, particularly for the taller structures (40-50 feet tall and higher). Improved understanding of floodplain limits and mitigation requirements has also resulted in alignments in the Central Valley to be raised on an embankment or placed on structures where prior conceptual alignment designs identified these to be at-grade.

As the high-speed train alignment shifts high above the existing grade on an aerial structure or well below the existing grade in a trench or tunnel, there will be a significant increase in costs given the much higher per mile cost for viaducts, trenches, and tunnels over at-grade alignments. A further breakdown of major cost changes are included in Appendix A. Specific cost distribution charts by percent for each project-level section is included in Appendix C.

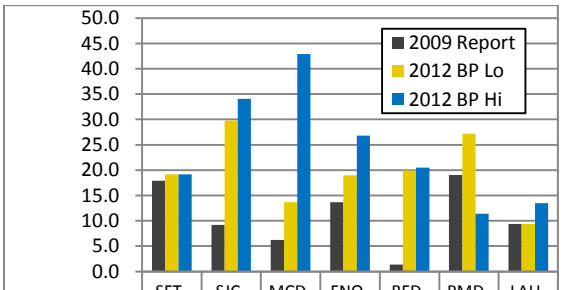
2.6 QUANTITIES AND UNIT PRICES

The current cost estimate is based on alignment alternatives that are at a 15% Design level of engineering or less. As such, there remain opportunities to reduce both scope and unit prices. The two variables of quantities and unit price have been assessed to determine why the capital costs have increased and to identify where opportunities exist to reduce costs. This section will address where quantities and costs have increased and where cost reduction may be achieved though the ongoing value engineering and cost containment efforts for the two most significant construction cost elements: Viaducts and Bridges, and Tunnels.

2.6.1 Viaducts and Bridges

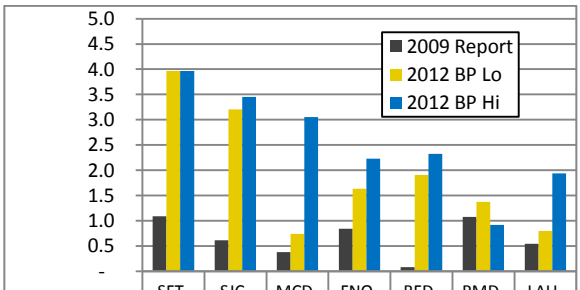
The following graphs show the increase in quantities and costs by section. The total length of Viaducts and Bridges for Phase 1 increased from 77 miles as included in the 2009 Report to 138/168 (Lo/Hi) miles based on the Pre-Draft and Draft 15% Design Submittals. Total construction costs for Viaducts and Bridges increased from $4.6 billion to $13.6/$17.9 (Lo/Hi) billion.

Exhibit 9
Viaduct and Bridges
Quantities in Miles



	SFT-SJC	SJC-MCD	MCD-FNO	FNO-BFD	BFD-PMD	PMD-LAU	LAU-ANA
2009 Report	17.9	9.2	6.2	13.7	1.3	19.1	9.4
2012 BP Lo	19.2	29.8	13.7	19.0	19.9	27.2	9.4
2012 BP Hi	19.2	34.1	42.9	26.8	20.5	11.4	13.5

Exhibit 10
Viaduct and Bridges
Construction Costs (2010$ billions)



	SFT-SJC	SJC-MCD	MCD-FNO	FNO-BFD	BFD-PMD	PMD-LAU	LAU-ANA
2009 Report	1.1	0.6	0.4	0.8	0.1	1.1	0.5
2012 BP Lo	4.0	3.2	0.7	1.6	1.9	1.4	0.8
2012 BP Hi	4.0	3.5	3.1	2.2	2.3	0.9	1.9

In the quantity and cost exhibits, there is a notable anomaly for the SFT-SJC where the quantities have increased slightly and the costs have more than doubled. This is caused, in part, by the

change of two-track structures accounted for in the Programmatic EIR/S cost estimates to the four-track structures now included in the estimate.

Increases in viaduct lengths are driven by a variety of stakeholder concerns, environmental impacts, and physical constraints. A general description for the key drivers of these changes is noted below by Section.

Section	Increase in Viaduct from 2009 Report	Description for Increase in Viaduct Lengths
San Francisco – San Jose	+ 1 miles (Lo and Hi)	Total length of viaducts is similar however the viaduct widths were increased from 2-track viaducts to 4-track viaducts for an integrated Caltrain / CHSTP operation, effectively doubling the cost of the previously assumed 2-track aerial structures.
San Jose – Merced	+21 miles (Lo) +25 miles (Hi)	Added viaduct in the City of San Jose south of Diridon Station to reduce ground level impacts and to address conflicts with UPRR and Caltrain. Added viaduct between San Jose and Gilroy as constraint points are too high and too close together to bring the alignment back to the ground level and is maintained as elevated structure. Additional viaduct length for the High Cost Option is to support a downtown Gilroy station and changes in alignment in the San Joaquin Valley.
Merced – Fresno	+ 7 miles (Lo) +37 miles (Hi)	HST facility could not be at-grade due to proximity of Gateway Drive, a main roadway in the city of Madera, which runs parallel to the UPRR and HST line. Added aerial structure for the Central Valley Wye connections which was not included in the Program Level Estimate. Additional viaduct length for the High Cost Option is primarily for an elevated alignment adjacent to the UPRR
Fresno – Bakersfield	+ 5 miles (Lo) + 13 miles (Hi)	Increase viaduct to address multiple freight railroad, floodplain and waterway crossings throughout the Central Valley. Added viaduct in Bakersfield to minimize impacts to City streets, residences, and businesses. Additional viaduct length for the High Cost Option is primarily for elevated alignment options running through Wasco, Shafter, and Corcoran.
Bakersfield – Palmdale	+19 miles (Lo) +19 miles (Hi)	2009 Report alignment, which is the same as the alignment in the Program EIR/S, included several features related to maximum gradient and minimum curvature that are inconsistent with geometric requirements for modern high-speed train systems operating at 220 mph. Adherence to current design criteria for gradient and horizontal curves resulted in the need for additional viaducts.
Palmdale – Los Angeles	+ 8 miles (Lo) - 8 miles (Hi)	Increase in viaduct is driven by the shift of the alignment from Soledad Canyon to the SR-14 West Option, and to accommodate an at-grade crossing at the Santa Susanna Fault. For the High Cost Option, the decrease in viaducts is accompanied by increases in Tunnel lengths and costs.
Los Angeles -- Anaheim	+ 0 miles (Lo) + 4 miles (Hi)	2009 Report assumed Dedicated Alternative; 2012 BP assumes the same for low cost option For the High Cost Option, the passenger tracks under Consolidated Shared Use Alternative need to be elevated and partially overhang the freight tracks in order to fit within existing right-of-way. This also requires structures to be taller to provide for freight gauge clearances.

In comparing increases in quantities with increases in costs for the viaducts and bridges, there appears to be a discrepancy as quantities increase approximately double and costs increase by two to three times. This indicates that in addition to the scope growth, there are increases attributable to the unit price for viaducts and structures, and to the type and/or height of structure.

From the 2009 Report to the 2012 BP, composite unit prices for viaducts and bridges were revised to more accurately reflect the variety of structure dimensions and types that were under consideration during development of the 15% Design submittals.

For the 5% Design (Conceptual Engineering) that was prepared to support the Program EIR/S, two types of structures were assumed for viaducts including Standard and High. The 5% Design estimates also included a separate cost for Long Span structures and structures crossing waterways. During the development of the 15% Design submittals, it was evident that definitions for viaduct costs needed to be expanded so that the costs could better reflect the viaduct structures required for the HST system. The expansion of viaduct cost definitions included a breakdown by pier height in 10-foot increments and addition of viaduct structures using straddle bents. These straddle bent supported structures are common where the CHSTP crosses over existing railroads and roadways on a heavy skew angle (see photo to the right).

The increase in composite unit prices for structure is significant and is noted below:

- Standard Structure (20-foot pier Height) went from $45 million per mile to $50 million per mile inclusive of contingencies, or a 10% increase in composite unit price.
- High Structures (30-50-foot pier Height) went from $52 million per mile to an average of $61 million per mile inclusive of contingencies, or a 17% increase in composite unit price.

Increases in viaduct unit prices are driven by both technical approaches and levels of safety performance. These include seismic considerations, maintenance and access, and construction means and methods. A general description for the key drivers of unit price changes from the 2009 Report and 2012 BP are noted in the following table and discussed in the two categories of Superstructure and Substructure (column and foundation).

Viaduct Structure Height	Increase in Unit Price	Description for Increase in Viaduct Unit Price Costs
20-foot Pier Height	+$4 M per mile +9% ($45.5 M vs. $49.7 m)	Superstructure – For planning purposes, superstructure depth increased from 7-feet to 10-feet to increase the structure stiffness due to passenger comfort criteria being raised commensurate with other modern high-speed rail systems planned to be operating at speeds up to 220 mph Substructure -- No significant change in costs
30-50 – foot Pier Height	+$9 M per mile +17% ($52.5 M vs. $61.5 M)	Superstructure -- Superstructure depth increased from 7-feet to 10-feet to increase the structure stiffness due to passenger comfort criteria being raised commensurate with other modern high-speed rail systems planned to be operating at speeds up to 220 mph Substructure -- Substructure costs increased due to greater seismic influence on taller structures and the need for larger columns and stronger foundations, specifically to improve rigidity of the structure and minimize displacement

As previously noted, approximately 15-20% of the increase viaduct costs are attributable to Unit Price Changes. The remaining 80-85% of the increase is caused by scope changes, both in terms of increased quantity and, in the case of viaducts, in terms of taller and more costly structures. The more refined definition of viaduct height developed for the 2012 BP cost estimate approach resulted in more structures being defined at the taller pier heights consistent with the alignment alternative information.

There are several cost reduction strategies related to viaducts and bridges that have been reviewed for feasibility during the cost containment effort for the Central Valley. In addition, studies are in process to reflect new technological advances and construction methods in the design and production rates assumed in developing the unit prices. Several of these cost reduction strategies are presented below from the more specific to a general application.

Scope Related Cost Reduction Efforts

Bring structure to grade – While the need for some viaduct structures is driven by physical constraints, some are driven by density of crossings. Viaduct structures are viewed as having less impact on the ground and local circulation, and provides positive (vertical) separation for the high-speed rail system from unauthorized access. However, viaducts are generally more costly to construct depending on the level of development and improvement on the ground plane. Where viaduct structures are not dictated by physical constraints, further dialogue with the local stakeholders can result in reduced viaduct structure. This has been the case with the cost containment efforts in the City of Fresno.

Reduce overall structure height – Viaduct structures for HSR are typically many miles long. The overall height of the structure is sometimes driven by an isolated physical constraint (i.e. freeway overcrossing) which cannot be avoided. One strategy to employ is to use a through-girder bridge at the constraint point which allows the overall viaduct structure to be reduced in height.

Design Variances – Variances from the design criteria can be applied where performance and safety are not compromised or can otherwise be mitigated, and where costs can be reduced. Use of Design Variances to reduce costs is explored during both cost containment and value engineering efforts. As identified during the cost containment efforts, Design Variances have resulted in reduced structure lengths for the Fresno-Bakersfield section.

Cost Containment – Cost containment is an ongoing effort and can occur after the initial alignments and costs have been developed, typically after the In-Progress 15% Design Submittals. Cost Containment has been implemented for Fresno-Bakersfield and Merced-Fresno Sections and has resulted in additional lower cost alignment alternatives to be included in the Environmental Review process.

Value Engineering (VE) – Formal Value Engineering will use the Final 15% Design Submittal and development of the 15% Design Cost Estimate as a basis of assessment. Value engineering focuses on the preferred alignment, if identified, or will address all alternatives carried forward into the environmental process. The results of the VE process will be reflected in the Draft 30% Design submittals. Value Engineering can occur at three levels within the CHSTP program as outlined below:

- Level 1 Program Wide – Confirm baseline performance, and function objectives
- Level 2 Project Wide – Review design criteria project wide standardization of materials, structural types and components, route wide procurement and management efficiencies
- Level 3 Regional Specific – Review alternative design solutions to major components that achieve functions and design criteria while maintaining quality and safety at lower cost

Unit Price Related Cost Reduction Efforts

Reduced Viaduct Structure Width – The team has developed a narrower structure reducing the total width from 50-feet to 43-feet. This change in design standard is being incorporated into the unit prices and will result in some reduction.

Reduced Structure Depth – In developing the profile at the 15% Design level, structure depth is assumed at 1:10 Depth to Span. Further analyses were performed for the standard span aerial structure which indicates that the structure depth to span ratio may be revised and would reduce superstructure quantities and costs. This will be confirmed during the seismic validation analysis for standard viaduct structures.

Ballasted vs. Non-Ballasted Track – Use of non-ballasted track would reduce the overall mass on the superstructure and reduce the overall costs. While this general assumption is appropriate for most long viaducts, this issue requires investigation for specific application regarding homogeneity of track structure as the Draft 15% Design Submittals are completed.

Construction Means and Methods – Span by span construction is very efficient and has become a standard construction approach for some HSR programs. This is not a typical construction method in the U.S. and cost data is not readily available. The team is currently assessing the cost reduction associated with more efficient methods of construction not typical in the U.S.

Seismic Isolation – In California, seismic isolation strategies are used to minimize structure costs. While common for roadway structures, this strategy is not typical of HST structures as movements transfer based on existing seismic isolation systems, particularly from small and frequent seismic events, can disturb the track alignment and disrupt or halt HST services. New seismic isolation technology has been developed and is currently undergoing testing. Although still under evaluation, the new technology addresses movement for frequent small earthquakes and is expected to be available to meet the CHSTP design and construction schedule. Seismic isolation has high potential to significantly reduce overall structure costs.

Unit price comparison for representative sample of structure types is presented as general information on the following table. Costs are inclusive of applicable contingencies.

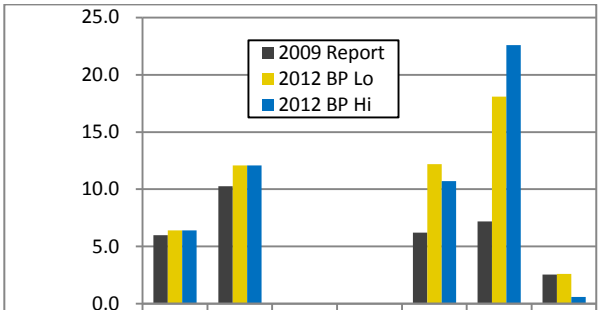
2009 Report Unit Price Element	2009 Report* ($1,000/mile)	2012 BP Unit Price Element	2012 BP* ($1,000/mile)
Standard Structure	45,464	Elevated – 2 Track (20' Avg. Pier Ht)	49,708
High Structure	52,552	Elevated – 2 Track (30'-50' Avg. Pier Ht)	61,554 (avg)
		Elevated – 2 Track (60'-70' Avg. Pier Ht)	83,473 (avg)
Long Span	80,495	Elevated Structure (LS) – 2 Track (20' Avg. Pier Ht)	54,849
		Elevated Structure (LS) – 2 Track (30'-50' Avg. Pier Ht)	67,928 (avg)
		Elevated Structure (LS) – 2 Track (60'-70' Avg. Pier Ht)	82,389 (avg)
Waterway Crossing	110,945	Included with LS Structure	Refer to LS Structure
Elevated Structure w/ Straddle Bents	Not included	Elevated Structure Straddle over 2 RR – 2 track (30' Avg. Pier Ht)	94,320

* Shown in 2009 $ for comparison purposes and includes contingencies

2.6.2 Tunnels

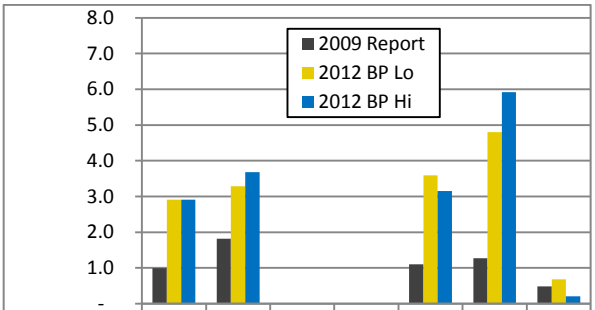
The graphs below show the increase in quantities and costs by section. The total length of tunnels for Phase 1 increased from 32 miles as included in the 2009 Report to 51/52 (Lo/Hi) miles based on the In-Progress and Draft 15% Design Submittals reflected in the 2012 BP. Total construction costs for tunnels increased from $5.7 billion to $15.3/$15.9 (Lo/Hi) billion.

Tunnels
Quantities in Miles



	SFT-SJC	SJC-MCD	MCD-FNO	FNO-BFD	BFD-PMD	PMD-LAU	LAU-ANA
2009 Report	6.0	10.3	0.0	0.0	6.2	7.2	2.6
2012 BP Lo	6.4	12.1	0.0	0.0	12.2	18.1	2.6
2012 BP Hi	6.4	12.1	0.0	0.0	10.7	22.6	0.6

Tunnels
Construction Costs (2010$ billions)



	SFT-SJC	SJC-MCD	MCD-FNO	FNO-BFD	BFD-PMD	PMD-LAU	LAU-ANA
2009 Report	1.0	1.8	-	-	1.1	1.3	0.5
2012 BP Lo	2.9	3.3	-	-	3.6	4.8	0.7
2012 BP Hi	2.9	3.7	-	-	3.2	5.9	0.2

Increases in tunnel lengths are primarily between Bakersfield and Los Angeles and are driven by a combination of stakeholder concerns, environmental impacts, and physical constraints. A general description for the key drivers of these changes is noted below by Section.

Section	Increase in Tunnels from the 2009 report	Description for Increase in Tunnel Lengths
San Francisco – San Jose	+less than one mile (Lo and Hi)	Increase is for a single track cut-and-cover tunnel to reduce facility footprint and eliminate direct impact to existing residential and planned development in the area of Millbrae station. Soils are very poor. Currently assuming sequential excavation methods of construction.
San Jose – Merced	+2 mi (Lo and Hi)	Tunnels needed to be deeper and longer to avoid the slip plane areas of land slide zones. Assumes an accelerated schedule with multiple work faces.
Merced – Fresno	NA	There is a very short tunnel in this section which has been costed as a railroad underpass.
Fresno – Bakersfield	NA	No tunnels in this Section
Bakersfield – Palmdale	+ 6 mi (Lo) + 5 mi (Hi)	2009 Report alignment, which is the same as the alignment in the Program EIR/S, included several features related to maximum gradient and minimum curvature that are inconsistent with geometric requirements for modern high-speed train systems operating at 220 mph. The alignment developed for the 2012 BP estimate is for a different alignment than was assumed for the 2009 Report.

Palmdale – Los Angeles	+11 mi (Lo) +15 mi (Hi)	Soledad Canyon Viaduct alternative was eliminated due to impacts to environmentally protected species and habitats (i.e. red legged frog, least bills verio). Alternate alignments required long tunnels and viaducts due to heavy terrain. For the High Cost option, added tunnel approach into LAUS to avoid existing park which is adjacent to the LA River. Tunnel had to be extended to cross under LA River as well. Also added tunnel length to eliminate impacts to residential areas of Santa Clarita
Los Angeles - Anaheim	No change (Lo) -2 miles (Hi)	2009 Report assumed Dedicated Alternative, 2012 BP the same. For the High Cost option, Consolidated Shared Use Alternative eliminated the tunnel approach to the ARTIC Station.

At the Program level (5% Design, Conceptual Engineering), tunnel costs were generated assuming a uniform geotechnical condition reflecting the data available for that level of study. Additional geotechnical studies consistent with 15% design efforts have identified a variety of geotechnical conditions (soft soil, competent soils, hard rock, etc) for which cost variations are applied. From the 2009 Report to the 2012 BP estimate, cost items and unit prices for tunnels were expanded and revised to better reflect the variety of soil types and applicable construction methods identified during development of the 15% Designs.

Increases in tunnel unit prices are driven by both technical approaches and access to site for labor, equipment and materials. A general description for the key drivers of unit price changes from the 2009 Report and 2012 BP are noted in the following table.

Tunnel Size and Construction Method	Increase in Unit Price	Description for Increase in Tunnel Unit Price Costs
Twin Tunnel, Single Track, TBM Hardrock	+$15 m per mile +14% *($106 m vs $121 m)*	2009 Report unit rates were developed from historical bid prices from smaller and shorter mass transit tunnels in flat soft ground urban areas factored up to larger and longer high speed rail tunnels. 2012 BP composite unit prices have been developed bottom up from labor, material and equipment requirements for tunnels in remote mountainous locations with difficult ground conditions and access and environmental constraints. Increase is also due to resources being matched to a 4 year civil construction schedule which requires additional TBMs to complete the tunnels which have increased in length.
Cut and Cover, Double Track 40-foot depth	+$13 m per mile +10% *($131 m vs $144 m)*	2009 Report estimate did not fully account for cost of depth and type of temporary excavation support walls and ground treatment to invert plug in soft ground with water pressure

There is a 59-62% increase in tunnel quantities and a 170-180% increase in tunnel costs from the 2009 Report to the 2012 BP Lo/Hi Cost estimates. This apparent inconsistency in comparing growth in quantities and costs is due to both increases in unit price and identification of soft or poor soil conditions which can significantly increase construction costs.

A peer review for tunnel unit prices was conducted in the fall of 2010 and the results indicated that the cost per mile for the various tunnel construction methods fell within a reasonable range. It should be noted that 30% contingency is allocated to the tunnel costs.

Generally, the increase in tunnel costs is caused by scope changes, both in terms of increased quantity (increased length) and in terms geotechnical considerations (i.e. poor geotechnical conditions).

There are several cost reduction strategies related to tunnels that can be reviewed and applied as the design progresses and additional information is available. In addition, studies are in process to review the specific tunnel lengths and locations to confirm tunnel requirements and opportunities to reduce costs. Several of the cost reduction strategies under consideration are presented below from the more specific to a general application. It should be noted that while tunnel construction means and methods are well understood and quantified for a variety of soil conditions, the risk and variability in tunnel costs typically reflect the uncertainty of final dimensions and site geotechnical conditions. Tunnel dimensions and geotechnical conditions are continually refined as additional information is collected, assessed and applied to generate a more accurate construction cost and schedule.

Scope Related Cost Reduction Efforts

Reduce Tunnel Lengths – Tunnel lengths are subject to the terrain and geotechnical conditions at selected portal sites. As additional and more accurate information is known, portal locations and tunnel lengths can be optimized to suit site conditions. Tunnel lengths can also be significantly affected by gradient and other geometric conditions. The discussion below on Design Variances addresses cost reduction opportunities related to alignment criteria.

Single Bore Tunnels – For series of short tunnels (1600 feet or less), it may be possible to use 40' single bore, two track tunnels. While not a significant cost savings for tunnels, costs reductions may be realized for any structures that attach to the tunnel portals. A single bore tunnel uses a single structure and twin bore tunnels require two separate structures.

Design Variances – Variances from the design criteria can be applied where performance and safety are not compromised or can otherwise be mitigated, and where costs can be reduced. The most effective would be regarding maximum gradients and length of sustained grades. Allowing some variances from the design criteria can have significant effect on total tunnel lengths. As the progress through the design development process, the three sections with multiple and long tunnels (San Jose-Merced, Bakersfield-Palmdale, Palmdale-Los Angeles) are reviewing where design variances can provide cost reductions and not compromise performance and safety of the HST system.

Cost Containment – Cost containment is an ongoing effort and can occur after the initial alignments and costs have been developed, typically following the Pre-draft 15% Design Submittals.

Value Engineering (VE) – Formal Value Engineering will use the Final 15% Design Submittal and development of the 15% Design Cost Estimate as a basis of assessment and as further described in the discussion on Viaducts and Bridges.

Unit Price Related Cost Reduction Efforts

Reduced Tunnel Diameter – For long tunnels at the highest speeds, analysis indicates that the tunnel diameter may be reduced from the current 30' diameter to 28.5' diameter. This will result in an incremental decrease in the unit price.

Reduced Speed in Tunnels – Tunnels costs are directly related to tunnel diameter, which in turn is directly related to train speed, vehicle cross-sectional area, and length. Restricting operating speed in tunnels can reduce tunnel construction costs but will incrementally increase the journey time between City pairs.

Contingency – Contingency is generally allocated on the basis of the risk of unknown or unaccounted cost elements. For tunnels, this typically includes the uncertainty of the ground and is refined by collecting additional data via subsurface investigations. The 2009 Report approach of a uniform geotechnical conditions and limited construction methods also represents a higher

risk than the 2012 BP approach of having unit costs for a variety of ground conditions and expanded construction methods. Currently, a 30% contingency is allocated to both the 2009 Report and 2012 BP cost estimates. Further consideration for a risk based application of contingency may reduce the overall costs for tunnels in the 2012 BP Estimate.

2.7 PEER REVIEWS OF COST ESTIMATES

Given the increase in construction costs, two peer reviews were conducted to assess the accuracy and validity of the cost estimating methodology applied to the 2012 BP Capital Cost Estimates. These include:

- Selected Cost Item Peer Reviews by Regional Consultants
- Contractor Bid Peer Review for the Merced- Fresno and Fresno-Bakersfield sections

The Selected Cost Item Peer Review included having Regional Consultant teams assess the composite unit price of several major cost items including Viaducts, Tunnels, Embankment, and retaining walls/trenches. Each of the cost items were reviewed by two teams. The design and material, equipment and labor assumptions were provided for the peer review. Generally, the findings of the peer review found that the composite unit prices were within a reasonable range, although some adjustments were incorporated into the 2012 BP cost estimates based on these reviews.

The Contractor Bid Peer Review was conducted by the PMO (Program Management Oversight) Team who hired a contractor (National Constructors) to generate a contractor bid price based on the Draft 15% Design Submittal for the Merced-Fresno and Fresno-Bakersfield sections. This section consisted primarily of civil-infrastructure work. Similar to a bid process, no cost information was provided to the contractor. The initial results from the contractor was a preliminary bid estimate within 10% of the PMT cost estimate. This result was accepted as confirmation that the PMT estimating methodology was producing reasonable results.

3.0 SUMMARY AND RECOMMENDATIONS

This assessment of cost estimates highlights that the capital costs will continue to be somewhat variable until completion of the environmental documents for all of the sections. There are two major factors for a continued dynamic environment for cost reporting. First is the wide-ranging status of development for the Phase 1 designs from conceptual to preliminary engineering (15% Design). The second, and most contributory, is that Phase 1 capital costs for structural elements affected by vertical alignment are significantly affected by site conditions, and stakeholder/environmental issues, impacts, and mitigation. These include viaducts, tunnels, trenches and retaining walls.

It is recommended that a process be established to prepare "Snapshot" estimates on a quarterly basis for review with the Authority to determine appropriate actions with respect to remaining environmental review processes. The snapshot estimates should include relevant alignment options and mitigations for each of the sections to support decision making in conjunction with a change control process.

Appendix A

Cost Comparison Memos by Section

SAN FRANCISCO – SAN JOSE SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The Current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced – Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Current Estimated Capital Costs for the San Francisco - San Jose Section is $13.6 billion in 2010 Base Year dollars and reflect Alignment Alternative A that implements 4-track configuration within existing Caltrain rail corridor. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $5.3 billion in 2009 Base Year Dollars. Taking into consideration recorded level of escalation1 in construction costs between Base Year 2009 and Base Year 2010, the capital cost for the San Francisco - San Jose Section results in a comparable value of $5.4 billion for the 2009 Report cost estimate to use in comparison with the current cost estimate. The results are an increase in estimated capital costs of $8.2 billion (152% increase). While some of the increase is attributable to changes in composite unit price costs for some of the construction elements, the majority of the increase in capital costs is due to changes in the alignment to address identified site conditions and local stakeholder concerns.

The majority of the cost changes (83%) from 2009 Report to the Current Estimate reflecting Alternative A include:

- $ 2,898 million for additional bridges and viaducts. Although the total length of viaducts increased by approximately 1 mile along with significant increases in structure heights in other areas, approximately $1.4 billion of these cost increases are associated with staged construction, loss of efficiency and allowances for force account and premium pay - all to account for continuous support of rail operations in the corridor. In addition, the viaduct widths were increased from 2-track viaducts to 4-track viaducts for an integrated Caltrain / CHSTP operation
- $1,927 million for additional tunnels in order to avoid direct impacts to existing and planned residential developments in Millbrae
- $ 934 million for additional earthworks and retaining walls to reduce footprint to the limits of existing right-of-way, approximately $241 million of these cost increases are associated with staged construction, loss of efficiency and allowances for force account and premium pay - all to account for continuous support of rail operations in the corridor.
- $ 472 million for increased right-of-way acquisition and relocation costs based on parcel specific assessments
- $ 331 million for additional traction power and electrification cost to account for electrification of both CHSTP and Caltrain tracks for an integrated Caltrain / CHSTP operation.

[1] 2009 Base Year to 2010 Base Year escalation was estimated at 1.98% based on Construction Cost Index as published by ENR.

- $ 266 million for increased grade separations costs to account for additional staged construction and traffic maintenance to maintain vehicular and rail traffic

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition, etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The cost estimates which were updated for the 2009 Report to the Legislature typically includes a 30% contingency which is applied to the total construction and ROW acquisition costs. The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions.

San Francisco – San Jose Cost Reconciliation
2009 Report to Current Estimate (Alignment Alternative A)

Item		Costs $ million	% of Delta	Comments
Report to the Legislature December 2009	$	5,282		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$	106		2% Escalation from Base Year 2009 $ to Base Year 2010 $
Report to the Legislature December 2009 +	$	5,388		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ Bridges & Viaducts	$	2,898	35%	Although the total length of viaducts increased by approximately 1 mile along with significant increases in structure heights in other areas, most of these cost increases (approx. $2.3B) are associated with staged construction, loss of efficiency and allowances for force account and premium pay - all to account for continuous support of rail operations in the corridor. In addition, the viaduct widths were increased from 2-track viaducts to 4-track viaducts for an integrated Caltrain / CHSTP operations.
+ Tunnels	$	1,927	24%	A single track cut-and-cover tunnel was added to reduce facility footprint and eliminate direct impact to existing residential and planned development in the area of Millbrae station
+ EW / RW	$	934	11%	Approximately 5.3 miles of retaining walls was added to avoid ROW impacts along Caltrain corridor.
+ROW	$	472	6%	Right-of-way costs increases are based on parcel specific assessment of acquisition and relocation costs. Programmatic EIR is based on acreage and land use.
+ Grade Seps	$	266	3%	Increase in grade separation costs due to additional allowances to account for staged construction and maintenance of traffic in the congested corridor.
+ Traction Electrification	$	331	4%	Additional traction power and electrification cost to account for electrification of both CHSTP and Caltrain tracks for an integrated Caltrain / CHSTP operation.
+ Misc	$	1,356	17%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
Alternative A	$	13,572	100%	Estimated Construction Costs as of 07/22/2011 - Low Range

SAN JOSE – MERCED SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The Current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced - Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Current Estimated Capital Costs for the San Jose - Merced Section range from $13.2 to $16.4 billion in 2010 Base Year dollars. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $5.7 billion in 2009 Base Year Dollars. However, the Diridon Station cost ($261 million) reflected in the Low and High Range cost estimates for the San Jose - Merced section is additive from San Francisco – San Jose section and includes significant betterments relative to a typical HSR station configuration assumed in 2009 Report. Escalation ($113 million) is also an additive cost as a function of the time value of money. Taking these into consideration results in a comparable value of $6.0 billion for the 2009 Report cost estimate to use in comparison with the current Low and High Range cost estimates. The results are an increase in estimated capital costs of $7.2 billion to $10.4 billion (119% to 171% increase). While some of the increase is attributable to changes in composite unit prices costs for some of the construction elements, the majority of the increase in costs is due to changes in the alignment to address identified site conditions and local stakeholder concerns. In considering the full range of alternatives, the Low Cost Alternative with more at-grade facilities is more similar physically to the HSR alternative outlined in the Programmatic EIR/S than the High Cost Alternative which includes significantly greater tunnel and trench infrastructure.

The majority of the cost changes (86%) from 2009 Report to the current Low Cost Alternative include:

- $ 2,607 million for added viaduct in the City of San Jose to reduce ground level impacts and to address conflicts with Union Pacific Railroad and Caltrain. Also, more viaduct structures have been implemented in Central Valley avoiding impacts to natural resources
- $ 1,483 million for deeper and longer tunnels to avoid the slip plane areas of land slide zones. Recent tunneling estimates also reflect shortest durations further increasing construction costs
- $ 1,091 million for additional grade separations identified through more detailed engineering for the Gilroy/Morgan Hills at-grade alignment option in combination with increased configuration complexity
- $ 646 million increase in utility relocation costs to account for relocations of high-voltage transmission line towers and due to increased footprint of grade separations
- $ 324 million for increased right-of-way acquisition and relocation costs based on parcel specific assessments

The majority of the cost changes (91%) from the current Low Cost Alternative to the High Cost Alternative include:

- $ 338 million for ~1 mile of additional viaduct structure to accommodate alignment alternative along US 101 with Gilroy downtown station and ~3 miles of additional viaduct in San Joaquin Valley
- $ 375 million for ~1.5 miles of cut and cover tunnels to accommodate alignment alternative along US 101 and Gilroy downtown station
- $1,994 million for ~8 mile long trench to accommodate alignment alternative along US 101 with Gilroy downtown trench option

- $ 166 million for increased environmental mitigation and temporary facility costs which are a fixed percentage of the capital costs

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies for the Low and High Range cost estimates are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition, etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The cost estimates which were updated for the 2009 Report to the Legislature typically includes a 30% contingency which is applied to the total construction and ROW acquisition costs. . The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions.

San Jose - Merced Cost Reconciliation

2009 Report to DEIR/S Low Range Option and DEIR/S Low Range to High Range Option

Item	Costs $ million	% of Delta	Comments
Report to the Legislature December 2009	$ 5,667		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$ 113		2% Escalation from Base Year 2009 $ to Base Year 2010 $
+ Diridon Station	$ 261		Diridon Station was moved from San Francisco - San Jose section. This cost reflects the difference in capital cost between a typical station configuration assumed in 2009 Report and the current design that includes betterments.
Report to the Legislature December 2009 +	$ 6,041		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ Bridges & Viaducts	$ 2,607	36%	Added viaduct in the City of San Jose to reduce ground level impacts and to address conflicts with UPRR and Caltrain.
+ Tunnels	$ 1,483	21%	Tunnels needed to be deeper and longer to avoid the slip plane areas of land slide zones.
+ROW	$ 324	5%	Right-of-way costs increases are based on parcel specific assessment of acquisition and relocation costs. Programmatic EIR is based on acreage and land use.
+ Grade Seps	$ 1,091	15%	Six additional grade separations were identified through more detailed engineering in combination with increased complexity in San Joaquin Valley/Henry Miller Rd. and Gilroy areas.
+ Utility Relocations	$ 646	9%	Additional utility impacts have been identified through outreach and coordination with utility companies and more detailed engineering
+ Misc	$ 1,037	14%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
Low Cost Alternative	$ 13,229	100%	Estimated Construction Costs as of 07/22/2011 - Low Range
+ Bridges & Viaducts	$ 338	11%	Approximately 1 mile of viaduct structure is added to accommodate alignment alternative along US 101 with Gilroy downtown station, and approximately 3 miles of viaduct structure is added in San Joaquin Valley.
+ Tunnels	$ 375	12%	Approximately 1.5 miles of cut and cover tunnels are added to accommodate alignment alternative along US 101 and Gilroy downtown station.
+ EW / RW	$ 1,994	63%	Approximately 8 mile long trench is added to accommodate alignment alternative along US 101 with Gilroy downtown trench option.
+ Env Mit, Temp Fac	$ 166	5%	Environmental Mitigation and Temporary Facilities increased significantly as these items are a fixed percentage of the construction costs
+ Misc	$ 288	9%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
High Cost Alternative	$ 16,391	100%	Estimated Construction Costs as of 07/22/2011 - High Range

MERCED – FRESNO SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The Current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced - Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Estimated Capital Costs included in the DEIR/S for the Merced - Fresno Section ranges from $3.8 to $6.7 billion in 2010 Base Year dollars. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $1.9 billion[2] in 2009 Base Year Dollars. However, several cost items in the Low and High Range cost estimates for the Merced - Fresno section are additive from other sections including Fresno Station ($124 million) and Central Valley Wye connection ($656 million) costs. Escalation ($39 million) is also an additive cost as a function of the time value of money. Taking these into consideration results in a comparable value of approximately $2.8 billion for the 2009 Report cost estimate to use in comparison with the Low and High Range cost estimates in the DEIR/S. The results are an increase in estimated capital costs of $1.0 to $3.9 billion (39% to 142% increase). While some of the increase is attributable to changes in composite unit price costs for some of the construction elements, the majority of the increase in costs is due to changes in the alignment to address identified site conditions and local stakeholder concerns. In considering the full range of alternatives, the Low Range alternative with more at-grade facilities is more similar physically to the HSR alternative outlined in the Programmatic EIR/S than the High Range alternative which includes significantly greater elevated infrastructure.

The majority of the cost changes (84%) from 2009 Report to the DEIR/S Low Range Option include:

- $ 583 million for additional earthworks and retaining walls to mitigate effects within the floodplain areas
- $ 178 million for increased right-of-way acquisition and relocation costs based on parcel specific assessments
- $ 142 million for realignment of approximately two miles SR-99 north of Fresno in a section of the alignment adjacent to the UPRR yard and is highly constrained

The majority of the cost changes (92%) from the DEIR/S Low Range Option to the DEIR/S High Range Option include:

- $2,397 million for ~30 miles of additional structure primarily for an elevated alignment adjacent to the UPRR
- $ 85 million for additional track costs primarily related to the increase in non-ballasted track for the additional elevated structures
- $ 159 million for increased environmental mitigation and temporary facility costs which are a fixed percentage of the capital costs

[2] The 2009 Report to Legislature includes a single cost estimate of $6.75 billion for Merced to Bakersfield. The portion attributable to the Merced – Fresno Section is ~$2.5 billion. The ~$2.5 billion cost estimate also includes the Heavy Maintenance Facility. The Low and High Range cost estimates do not include the Heavy Maintenance Facility. For purposes of this cost comparison, the Heavy Maintenance Facility costs (~$600 million including contingencies) were excluded in this reporting of the 2009 Report Cost Estimates for the Merced-Fresno section.

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies for the Low and High Range cost estimates are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition, etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The cost estimates which were updated for the 2009 Report to the Legislature typically includes a 30% contingency which is applied to the total construction and ROW acquisition costs. The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions.

Merced – Fresno Cost Reconciliation

2009 Report to DEIR/S Low Range Option and DEIR/S Low Range to High Range Option

Report to the Legislature December 2009	$	1,941		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$	39		2% Escalation from Base Year 2009 $ to Base Year 2010 $
+ Central Valley Wye	$	656		The Central Valley Wye is an addition to the M-F Section. It was not fully included in this section for the 2009 Report estimates.
+ Fresno Station	$	114		Fresno Station is included in M-F DEIR/S and the F-B DEIR/S for reporting purposes. Fresno Station was included only in the F-B section in the Programmatic EIR/S.
Report to the Legislature December 2009 +	$	2,749		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ EW / RW	$	583	54%	Additional earthworks and retaining walls to raise the alignments in the areas of floodplain
+ROW	$	178	17%	Right-of-way costs increases are based on parcel specific assessment of acquisition and relocation costs. Programmatic EIR is based on acreage and land use.
+ Highway Modification	$	142	13%	Realignment for ~2 miles of SR 99 just north of Fresno and adjacent to the UPRR yard
+ Misc	$	174	16%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
DEIR/S Low	$	3,827	100%	Estimated Construction Costs as reported in the DEIR/S for the Low Range
+ Bridges & Viaducts	$	2,324	81%	Includes ~30 additional miles of viaduct structures mostly for an elevated alternative along the UPRR. Low Range assumes a primarily at-grade alignment along the BNSF.
+ Track	$	85	3%	Increase in total length of structures also increased quantity for non-ballasted track
+ Env Mit, Temp Fac	$	156	5%	Environmental Mitigation and Temporary Facilities increased significantly as these items are a fixed percentage of the construction costs
+ Misc	$	302	11%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
DEIR/S High	$	6,694	100%	Estimated Construction Costs as reported in the DEIR/S for the High Range

FRESNO – BAKERSFIELD SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced - Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Estimated Capital Costs included in the DEIR/S for the Fresno - Bakersfield Section ranges from $6.2 to $7.2 billion in 2010 Base Year dollars. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $4.2 billion[3] in 2009 Base Year dollars ($4.3 billion in 2010 Base Year dollars). This results in an increase in estimated capital costs of $1.9 to $2.9 billion (45% to 68%). While some of the increase is attributable to increase in composite unit price costs for some of the construction elements, the majority of the increase in costs is due to changes in the alignment to address identified site conditions and local stakeholder concerns.

The majority of the cost changes (92%) from 2009 Report to the DEIR/S Low Range Option include:

- $ 798 million for additional elevated structures to cross railroads, highways, local streets of developed communities and increase in height for other structures such as the approach into downtown Bakersfield
- $ 364 million for additional earthworks and retaining walls to mitigate effects within the floodplain areas
- $ 296 million for addition of approximately 24 miles of intrusion protection barrier between the HSR and freight tracks
- $ 251 million for increased right-of-way acquisition and relocation costs based on parcel specific assessments
- $ 45 million for increases in grade separations costs due to complexity of improvements in the urban areas

The majority of the cost changes (92%) from the DEIR/S Low Range Option to the DEIR/S High Range Option include:

- $604 million for ~6 miles of additional structure for alignments options that run through Corcoran, Wasco, Shafter, and western portions of Bakersfield
- $ 316 million for additional intrusion protection barrier between the HSR and existing freight tracks as the High Range alignment has ~25 additional miles adjacent to freight tracks

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies for the Low and High Range cost estimates are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions.Fresno – Bakersfield Cost Reconciliation

2009 Report to DEIR/S Low Range Option and DEIR/S Low Range to High Range Option

[3] The 2009 Report to Legislature includes a single cost estimate of $6.75 billion for Merced to Bakersfield. The portion attributable to the Fresno-Bakersfield Section is ~$4.2 billion in 2009 $.

Item	Costs $ million	% of Delta	Comments
Report to the Legislature December 2009	$ 4,218		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$ 84		2% Escalation from Base Year 2009$ to Base Year 2010 $
Report to the Legislature December 2009 +	$ 4,302		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ Bridges & Viaducts	$ 798	42%	Includes ~6 additional miles of viaduct structures primarily for crossing railroads (BNSF) and highways (SR-198, SR-43,Westside Parkway) and local streets in developed communities not originally anticipated, and increased height of viaducts
+ EW / RW	$ 365	19%	Additional earthworks and retaining walls to raise the alignments principally in the areas of floodplain
+ Site Structures	$ 296	16%	Includes ~24 miles of intrusion protection barrier between the HSR and freight tracks
+ROW	$ 251	13%	Right-of-way costs increases are based on parcel specific assessment of acquisition and relocation costs. Programmatic EIR is based on acreage and land use.
+ Grade Seps	$ 45	2%	Increased costs reflects greater complexity for urban grade separations
+ Misc	$ 132	7%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
DEIR/S Low	$ 6,189	100%	Estimated Construction Costs as reported in the DEIR/S for the Low Range
+ Bridges & Viaducts	$ 604	61%	Includes ~6 additional miles of viaduct structures for an elevated alternative in Wasco, Shafter and Corcoran.
+ Site Structures	$ 316	32%	Costs are primarily for additional intrusion protection barrier between the HSR and freight tracks
+ Misc	$ 77	8%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
DEIR/S High	$ 7,187	100%	Estimated Construction Costs as reported in the DEIR/S for the High Range

BAKERSFIELD - PALMDALE SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The Current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced - Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Current Estimated Capital Costs for the Bakersfield - Palmdale Section range from $7.4 to $7.7 billion in 2010 Base Year dollars. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $4.1 billion in 2009 Base Year Dollars. Taking into consideration recorded level of escalation[4] in construction costs between Base Year 2009 and Base Year 2010, the capital cost for the Bakersfield – Palmdale Section results in a comparable value of $4.2 billion for the 2009 Report cost estimate to use in comparison with the current cost estimate. The results are an increase in estimated capital costs of $3.2 to $3.5 billion (79% to 84% increase). While some of the increase is attributable to changes in composite unit prices costs for some of the construction elements, the majority of the increase in costs is due to changes in the alignment to address identified site conditions and local stakeholder concerns. At this time, the difference between the Low and High Cost Alternatives is relatively small (approximately 3%). The Low Range alternative with more at-grade facilities and less tunneling perhaps is more similar physically to the HSR alternative outlined in the Programmatic EIR/S rather than the High Range alternative which includes more tunnels, elevated and retaining wall structures.

The majority of the cost changes (84%) from 2009 Report to the Low Cost Alternative include:

- $ 2,508 million for additional approximately 6 miles of tunneling due to more accurate topographic information and the resulting revised alignment alternatives from the programmatic preferred alternative definition that was assumed in the December 2009 Report
- $ 1,830 million for additional approximately 18.5 miles of viaduct structures due to more accurate topographic information and to stakeholder concerns resulting in substantially revised alignment alternatives from the programmatic preferred alternative definition that was assumed in the December 2009 Report
- ($1,430) million reduction in earthwork and retaining wall costs due to respective increases in viaducts and tunnels
- ($ 160) million reduction in grade separation costs due to increases in aerial and tunnel alignments crossing local roads and highways

The majority of the cost changes (69%) from the Low Cost Alternative to the High Cost Alternative include:

- $ 406 million for ~ 2 miles of additional very tall viaduct structures added to support alignment alternatives through Tehachapi region
- ($ 422) million cost reduction resulting from decrease in tunnel alignment lengths that were replaced with aerial and at-grade alignment configurations
- $ 164 million for additional retained embankments to minimize impacts through Antelope Valley alignment alternatives

[4] 2009 Base Year to 2010 Base Year escalation was estimated at 1.98% based on Construction Cost Index as published by ENR.

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies for the Low and High Range cost estimates are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition, etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The cost estimates which were updated for the 2009 Report to the Legislature typically includes a 30% contingency which is applied to the total construction and ROW acquisition costs. The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions. Bakersfield – Palmdale Cost Reconciliation

2009 Report to DEIR/S Low Range Option and DEIR/S Low Range to High Range Option

Item		Costs $ million	% of Delta	Comments
Report to the Legislature December 2009	**$**	**4,090**		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$	82		2% Escalation from Base Year 2009 $ to Base Year 2010 $
Report to the Legislature December 2009 +	**$**	**4,172**		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ Bridges & Viaducts	$	1,830	56%	Alignment alternatives have been substantially revised from the programmatic preferred alternative definition that was assumed in the December 2009 Report resulting in additional 18.6 miles of viaducts.
+ Tunnels	$	2,508	77%	Alignment alternatives have been substantially revised from the programmatic preferred alternative definition that was assumed in the December 2009 Report resulting in additional 6 miles of tunnels.
- EW / RW	$	(1,430)	-44%	Earthwork and retaining wall volumes were reduced due to increase in viaducts and tunnels
- Grade Seps	$	(160)	-5%	Number of grade separations reduced due to increases in aerial and tunnel alignment.
+ Misc	$	530	16%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
Low Cost Alternative	**$**	**7,449**	100%	Estimated Construction Costs as of 07/22/2011 - Low Range
+ Bridges & Viaducts	$	406	190%	Approximately 2 miles of additional very tall viaduct structures are added to support alignment alternatives through Tehachapi region.
- Tunnels	$	(422)	-197%	Amount of tunneling is reduced due to added aerial and at grade alignment alternatives.
+ EW / RW	$	164	77%	Retained embankments are introduced to minimize impacts through Antelope Valley alignment alternatives.
+ Misc	$	66	31%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
High Cost Alternative	**$**	**7,663**	100%	Estimated Construction Costs as of 07/22/2011 - High Range

PALMDALE – LOS ANGELES SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The Current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced - Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Current Estimated Capital Costs for the Palmdale – Los Angeles Section range from $11.6 to $13.1 billion in 2010 Base Year dollars. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $6.3 billion in 2009 Base Year Dollars. Taking into consideration recorded level of escalation[5] in construction costs between Base Year 2009 and Base Year 2010, the capital cost for the Palmdale – Los Angeles Section results in a comparable value of $6.4 billion for the 2009 Report cost estimate to use in comparison with the current cost estimate. The results are an increase in estimated capital costs of $5.2 to $6.7 billion (81% to 105% increase). While some of the increase is attributable to changes in composite unit prices costs for some of the construction elements, the majority of the increase in costs is due to changes in the alignment to address identified site conditions and local stakeholder concerns aimed at avoiding significant environmental and residential impacts. In considering the full range of alternatives, the Low Range alternative with more at-grade facilities and less tunneling is more similar physically to the HSR alternative outlined in the Programmatic EIR/S than the High Range alternative which reflects more tunneling and retained cut trench structures.

The majority of the cost changes (87%) from 2009 Report to the Low Cost Alternative include:

- $ 3,543 million for additional tunnels resulting from elimination of Soledad Canyon Viaduct alternative, which was the basis for the cost estimate in the December 2009, in order to avoid impacts to environmentally protected species and habitats. Alternate alignments require long tunnels and high viaducts due to heavy terrain.
- $ 933 million for additional cost to account for greater complexity of grade separations and roadways modifications in Los Angeles basin area.
- ($ 690) million decrease in earthwork costs due to increase in tunnel alignment lengths
- ($ 458) million decrease in station costs as current estimates reflect only one station in San Fernando Valley (two San Fernando stations were included in the 2099 Report estimate) representing a typical HSR station configuration excluding any guideway costs. Some guideway costs within station limits were included as station costs in the 2009 Report
- $ 327 million for additional utility relocation costs to account for relocations of high-voltage transmission line towers
- $ 897 million for increased right-of-way acquisition and relocation costs based on parcel specific assessments

The majority of the cost changes (85%) from the Low Cost Alternative to the High Cost Alternative include:

- $1,087 million for ~3.5 miles of additional tunnel in order to accommodate SR 14 East alignment alternative and a tunnel approach option into Los Angeles Union Station
- ($ 444) million reduction in viaducts costs due to increase in tunneled alignment configuration
- $ 288 million for about a mile of trench alignment associated with the tunneled approach in to Los Angeles Union Station

[5] 2009 Base Year to 2010 Base Year escalation was estimated at 1.98% based on Construction Cost Index as published by ENR.

- $ 265 million for additional ROW acquisition in order to implement "BVS" station option in San Fernando Valley
- $ 60 million for increased environmental mitigation and temporary facility costs which are a fixed percentage of the capital costs

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies for the Low and High Range cost estimates are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition, etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The cost estimates which were updated for the 2009 Report to the Legislature typically includes a 30% contingency which is applied to the total construction and ROW acquisition costs. The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions.

Palmdale – Los Angeles Cost Reconciliation
2009 Report to Current Estimate

Item		Costs $ million	% of Delta	Comments
Report to the Legislature December 2009	$	6,278		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$	126		2% Escalation from Base Year 2009 $ to Base Year 2010 $
Report to the Legislature December 2009 +	$	6,404		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ Tunnels	$	3,543	68%	Soledad Canyon Viaduct alternative was eliminated due to impacts to environmentally protected species and habitats (i.e. red legged frog, least bills verio). Alternate alignments require long tunnels due to heavy terrain.
+ Grade Seps	$	933	18%	Increased costs reflects much greater complexity for LA basin grade separations and modifications to roadways.
- EW / RW	$	(690)	-13%	Earthwork volumes decreased due to increase in tunnel alignment lengths.
- Stations	$	(458)	-9%	Current estimates reflect only one station in San Fernando Valley. Also the cost of this station decreased to represent a typical HSR configuration.
+ROW	$	897	17%	Right-of-way costs increases are based on parcel specific assessment of acquisition and relocation costs. Programmatic EIR is based on acreage and land use.
+ Utility Relocations	$	327	6%	Utility relocation costs increased to account for relocations of high-voltage transmission line towers
+ Misc	$	663	13%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
Low Cost Alternative	$	11,619	100%	Estimated Construction Costs as of 07/22/2011 - Low Range
- Bridges & Viaducts	$	(444)	-30%	Length of viaducts decreases due to increase in tunnel alignments.
+ Tunnels	$	1,087	74%	Approximately 3.5 miles of additional tunnel is added to accommodate SR 14 East alignment alternative and a tunnel approach option into Los Angeles Union Station.
+ EW / RW	$	288	19%	Added about a mile of trench alignment associated with the tunneled approach in to Los Angeles Union Station.
+ROW	$	265	18%	More ROW acquisition is required to accommodate "BVS" station option in San Fernando Valley.
+ Env Mit, Temp Fac	$	60	4%	Environmental Mitigation and Temporary Facilities increased significantly as these items are a fixed percentage of the construction costs
+ Misc	$	223	15%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
High Cost Alternative	$	13,099	100%	Estimated Construction Costs as of 07/22/2011 - High Range

LOS ANGELES - ANAHEIM SECTION

The 2009 Capital Cost Estimate for the Phase I (San Francisco - Anaheim) is based on the approved conceptual alignments at that time which are outlined in the Statewide Programmatic EIR/S published in 2005. The Current Capital Cost Estimate low and high range is based on alternative alignments being considered for environmental assessment including recently released Merced - Fresno and Fresno - Bakersfield DEIR/S documents. These alignments are based on conceptual and preliminary engineering studies (5% and 15% Design respectively). These alternative alignments attempt to address technical and stakeholder issues and concerns as identified during alternative analysis and environmental review processes.

The Current Estimated Capital Costs for the Los Angeles - Anaheim Section range from $5.6 to $6.0 billion in 2010 Base Year dollars. The Estimated Capital Costs as reported in the December 2009 Report to the Legislature is $4.6 billion in 2009 Base Year Dollars. Taking into consideration recorded level of escalation[6] in construction costs between Base Year 2009 and Base Year 2010, the capital cost for the Los Angeles - Anaheim Section results in a comparable value of $4.7 billion for the 2009 Report cost estimate to use in comparison with the current cost estimate. The results are an increase in estimated capital costs of $0.9 to $1.3 billion (19% to 27% increase). Considering that there haven't been significant changes in the preliminary design for the Low Cost Alternative (Dedicated Option) since 2009 Report, the majority of the increase in costs is attributable to changes in composite unit prices costs for some of the construction elements.

The majority of the cost changes (84%) from the Low Cost Alternative (Dedicated Option) to the High Cost Alternative (Consolidated Shared Use) include:

- $1,089 million for viaduct structures added to minimize ROW impacts
- ($ 458) million cost reduction resulting from eliminating tunnels from this option
- $ 38 million for increase in retaining walls to minimize ROW impacts
- $ 33 million for increase in amount of slab track construction due to increased viaduct lengths
- $ 430 million for additional improvements to existing Metrolink stations as HSR alignment remains predominantly within existing ROW
- ($ 213) million decrease in ROW acquisition costs as HSR alignment remains predominantly within existing ROW
- ($ 361) million decrease in utility relocation costs as HSR alignment remains predominantly within existing ROW
- ($ 304) million decrease in grade separation costs due to overall increase in aerial alignment configuration
- $ 35 million for increased environmental mitigation and temporary facility costs which are a fixed percentage of the capital costs

The cost estimates for these elements include allocated contingencies and implementation costs. The contingencies for the Low and High Range cost estimates are allocated by category of work (i.e. structures, track, traction power, facilities, ROW acquisition, etc.) and range from 10% to 25% depending on the level of engineering development and construction risk associated with the element. There is an additional Unallocated Contingency of 5% applied to the overall Low and High Range cost estimates to address unforeseen risk per FRA guidance. The cost estimates which were updated for the 2009 Report to the Legislature typically includes a 30% contingency which is applied to the total construction and ROW acquisition costs. The contingency applied during the Programmatic studies was sufficient to address changes in composite unit prices and unaccounted scope elements and did not adequately address local site condition challenges or issues and concerns raised by the local stakeholders and communities. The ranges of capital costs in the 2012 Business Plan account for the different route

[6] 2009 Base Year to 2010 Base Year escalation was estimated at 1.98% based on Construction Cost Index as published by ENR.

options under consideration and the potential mitigation costs for issues raised by local stakeholders and an improved understanding of site conditions.

Los Angeles - Anaheim Cost Reconciliation
2009 Report to Current Estimate

Item		Costs $ million	% of Delta	Comments
Report to the Legislature December 2009	$	4,628		Estimated Construction Costs as reported in the Dec 2009 Report to the Legislature
+ Escalation	$	93		2% Escalation from Base Year 2009 $ to Base Year 2010 $
Report to the Legislature December 2009 +	$	4,721		This subtotal includes those elements that are additive and not resulting from new information on site condition and stakeholder issues
+ Unit Price	$	694	77%	On average, changes in composite unit prices have increased construction costs by 15% over the 2009 Report estimates
+ Misc	$	212	23%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
Low Cost Alternative	$	5,627	100%	Estimated Construction Costs as of 07/22/2011 - Low Range
+ Bridges & Viaducts	$	1,089	315%	Viaduct structures were added to minimize ROW impacts.
- Tunnels	$	(458)	-133%	Tunneling was eliminated from this option.
+ EW / RW	$	38	11%	Increase in retaining walls to minimize ROW impacts.
+ Track	$	33	10%	Increased amount of slab track due to increase in viaducts.
+ Stations	$	430	125%	Added improvements to existing Metrolink stations as HSR alignment remains predominantly within existing ROW.
- ROW	$	(213)	-62%	Decrease in ROW acquisition as HSR alignment remains predominantly within existing ROW.
+ Utility Relocations	$	(361)	-104%	Decrease in utility relocations as HSR alignment remains predominantly within existing ROW.
- Grade Seps	$	(304)	-88%	Decrease in grade separation needs due to overall increase in aerial alignment.
+ Env Mit, Temp Fac	$	35	10%	Environmental Mitigation and Temporary Facilities increased significantly as these items are a fixed percentage of the construction costs
+ Misc	$	55	16%	Misc items include items with cost increases and cost decreases and represents the cumulative effect of all other items not specifically represented above. Misc items also includes Unallocated Contingency.
High Cost Alternative	$	5,972	100%	Estimated Construction Costs as of 07/22/2011 - High Range

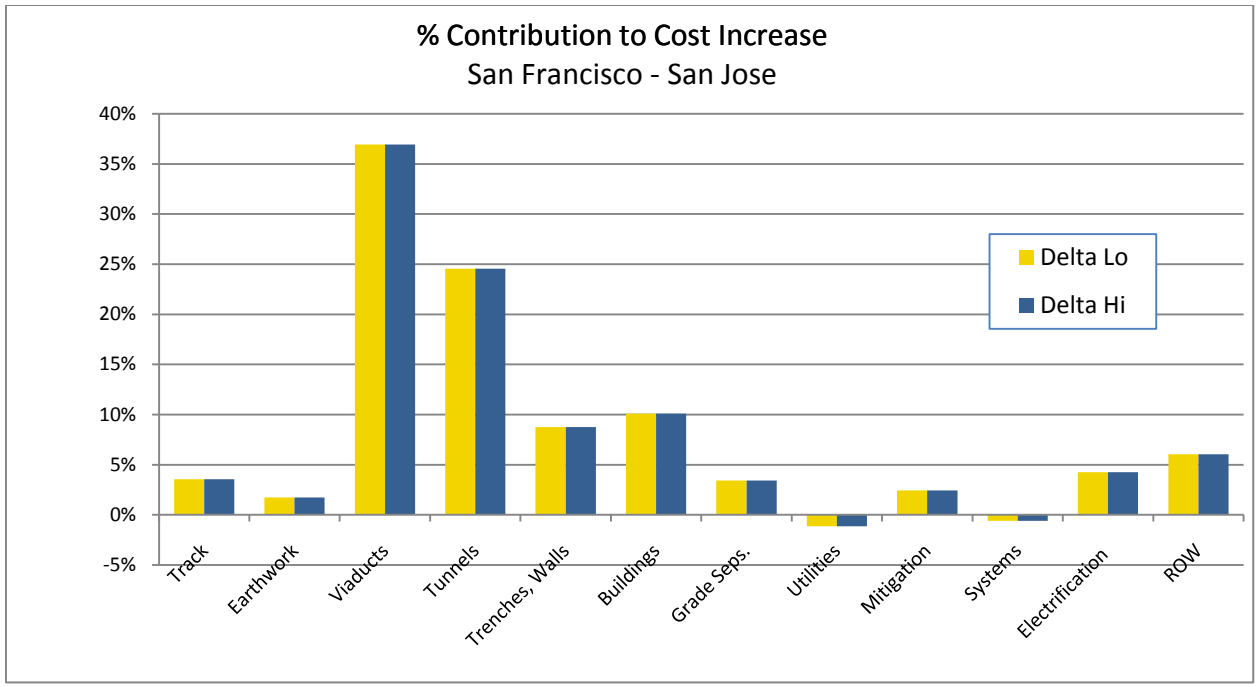
Appendix B

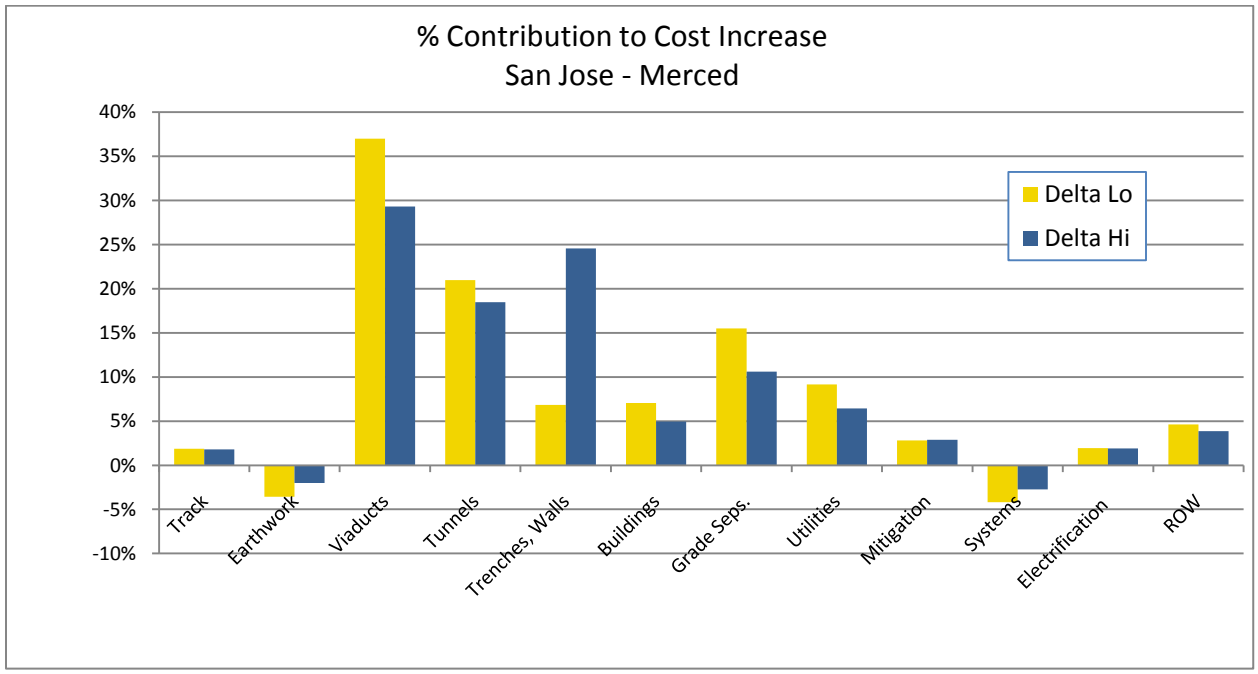
2012 BP Low/High Alternative Capital Cost Estimate
Alignment References

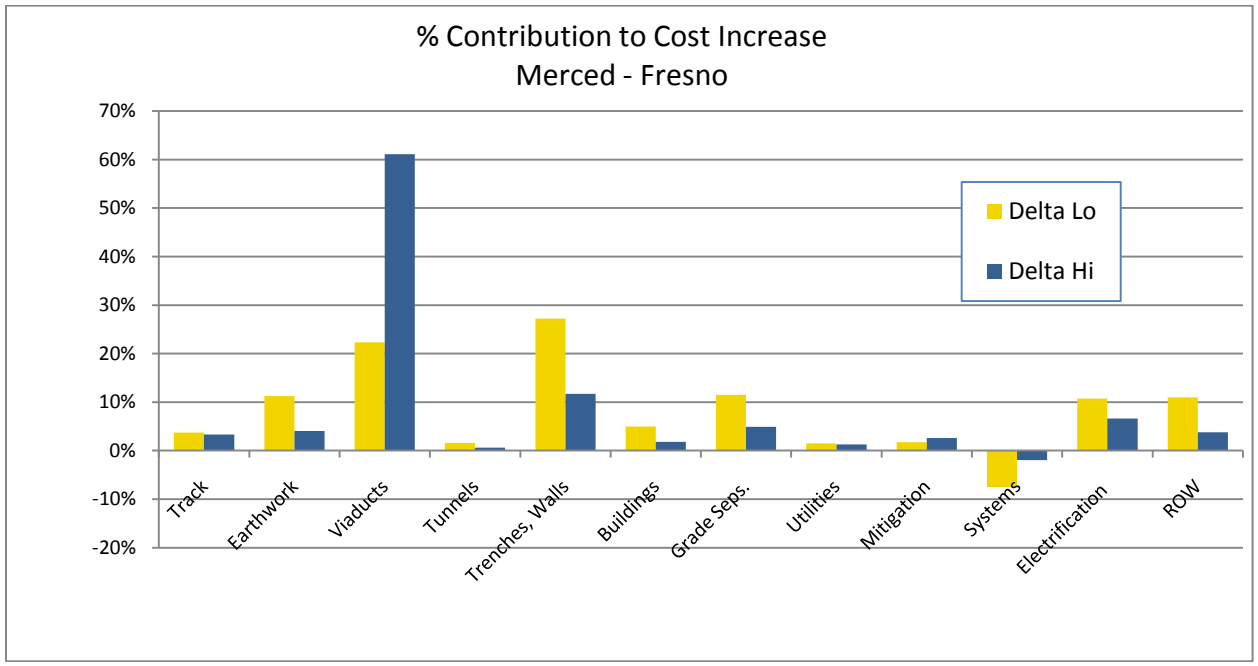
Environmental Section	Low Cost Alternative	High Cost Alternative
San Francisco to San Jose	Alignment Option A	Alignment Option A
San Jose to Merced	East of UPRR at-grade/Pacheco Pass SR152/SJV Henry Miller Avenue 24	US101 trench/Pacheco Pass Refined Programmatic/SJV Henry Miller Avenue 21
Merced to Fresno	Hybrid/Avenue 24 Alternative	UPRR/Avenue 24 Alternative
Fresno to Bakersfield	Corcoran Bypass/Allensworth/Wasco-Shafter/Bakersfield South	Corcoran Elevated
Bakersfield to Palmdale	E2/T3-1/AV4	E4/T3-2/AV3B
Palmdale to Los Angeles	SR14West/SFV-BSS/L1C-E	SR14East/SFV-BVS/LT1
Los Angeles to Anaheim	Dedicated Alternative	Consolidated Shared Use Alternative

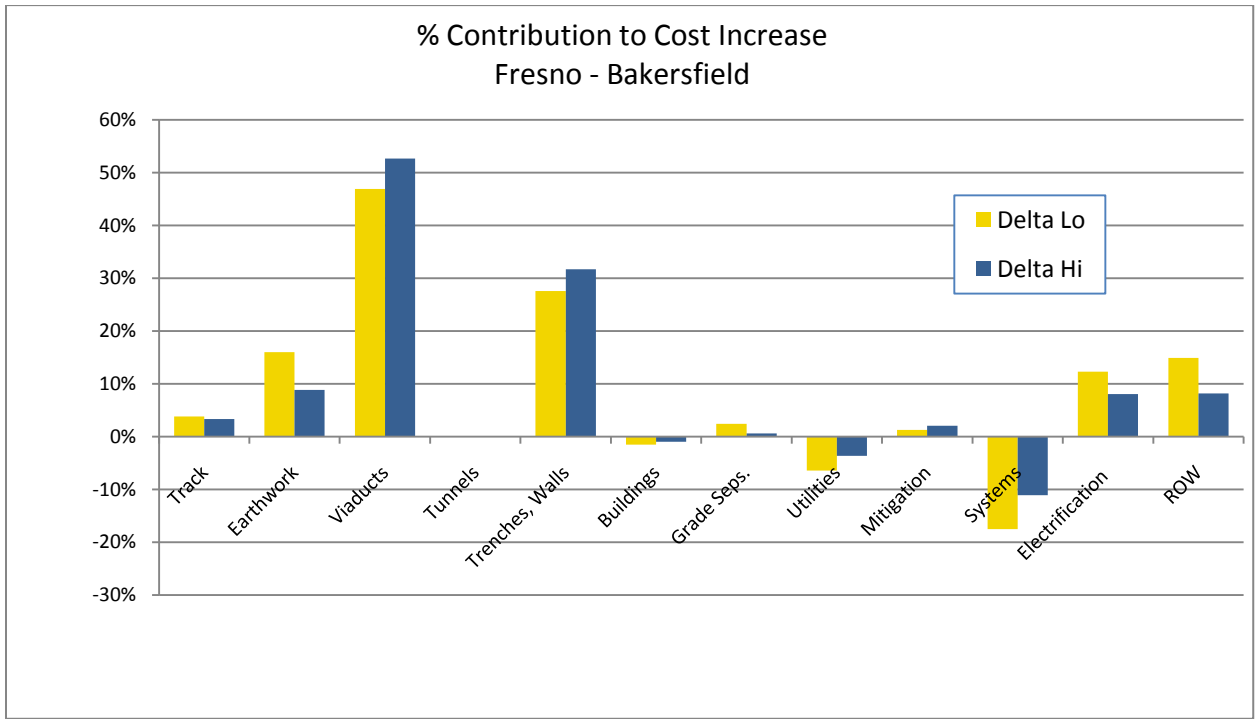
Appendix C

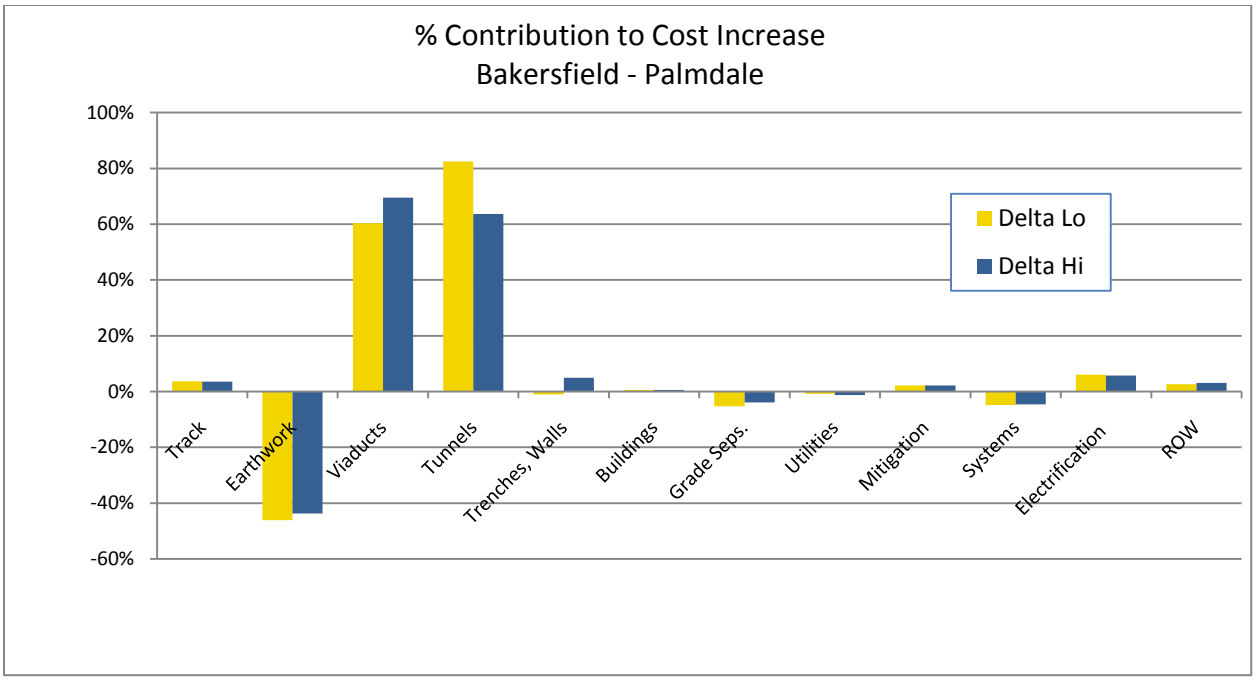
Percent Cost Increase Contribution by Section Charts

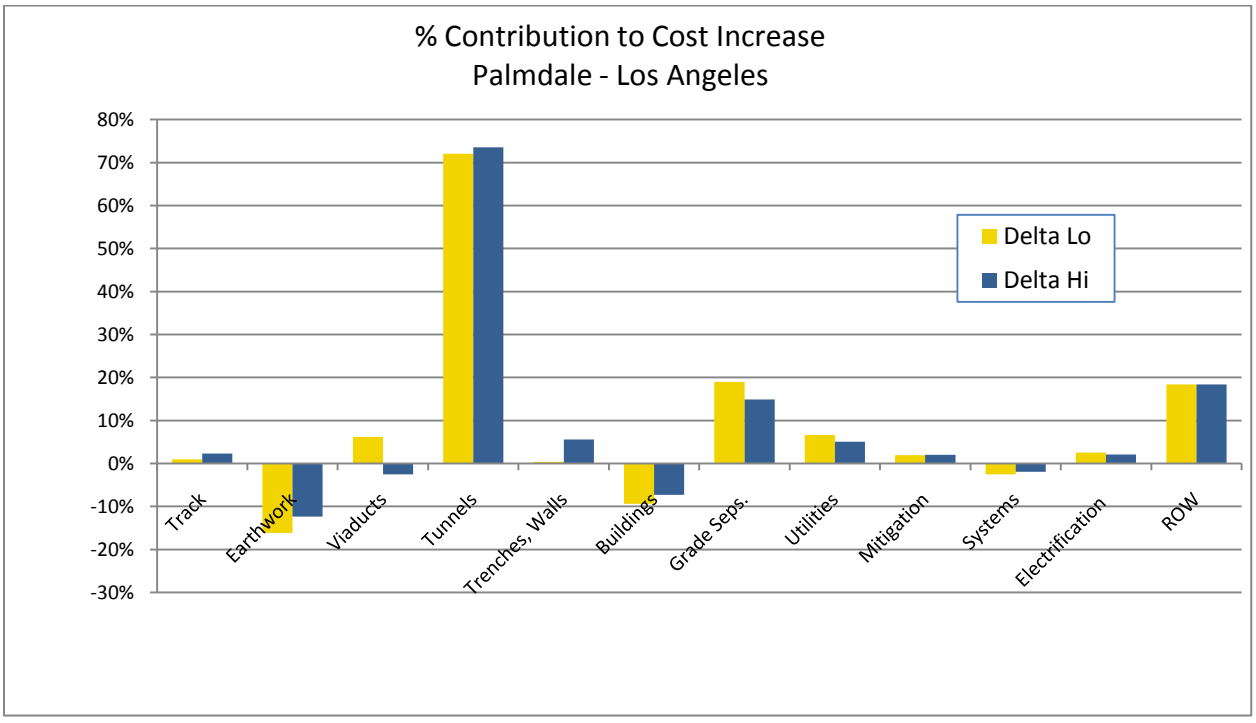

% Contribution to Cost Increase
San Francisco - San Jose
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW

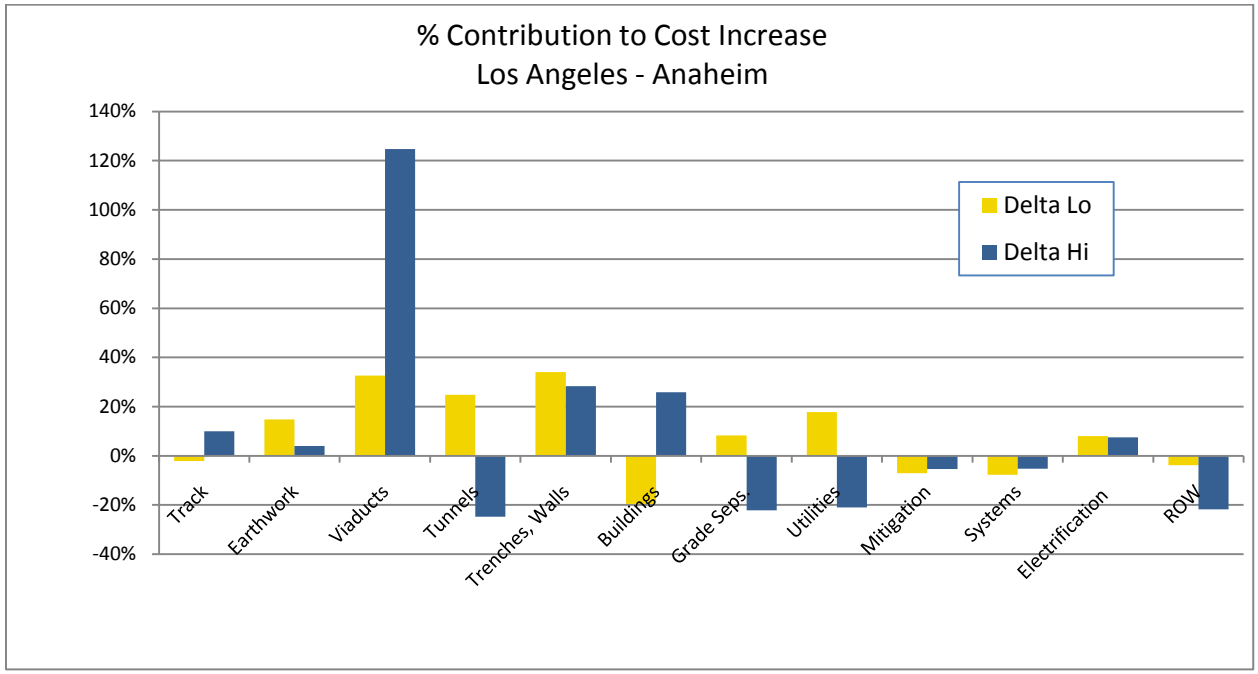

% Contribution to Cost Increase
San Jose - Merced
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW

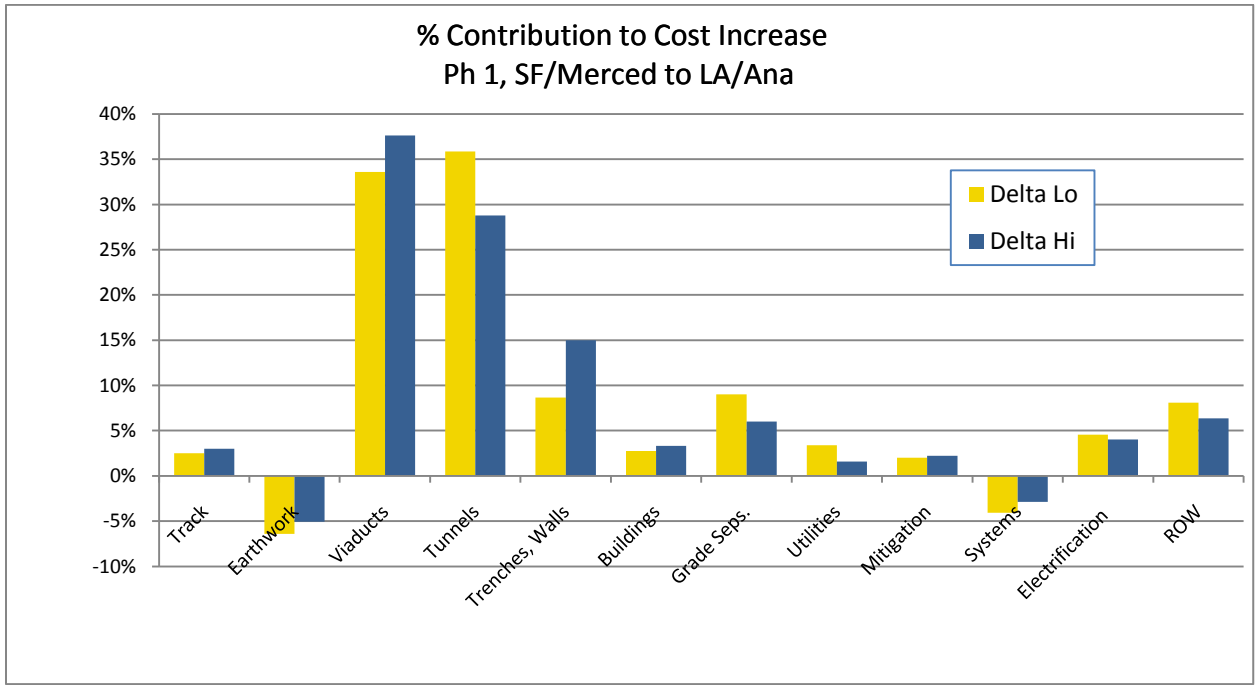

% Contribution to Cost Increase
Merced - Fresno
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW


% Contribution to Cost Increase
Fresno - Bakersfield
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW


% Contribution to Cost Increase
Bakersfield - Palmdale
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW


% Contribution to Cost Increase
Palmdale - Los Angeles
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW


% Contribution to Cost Increase
Los Angeles - Anaheim
140%
120%
100%
80%
60%
40%
20%
0%
-20%
-40%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW


% Contribution to Cost Increase
Ph 1, SF/Merced to LA/Ana
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
Delta Lo
Delta Hi
Track
Earthwork
Viaducts
Tunnels
Trenches, Walls
Buildings
Grade Seps.
Utilities
Mitigation
Systems
Electrification
ROW